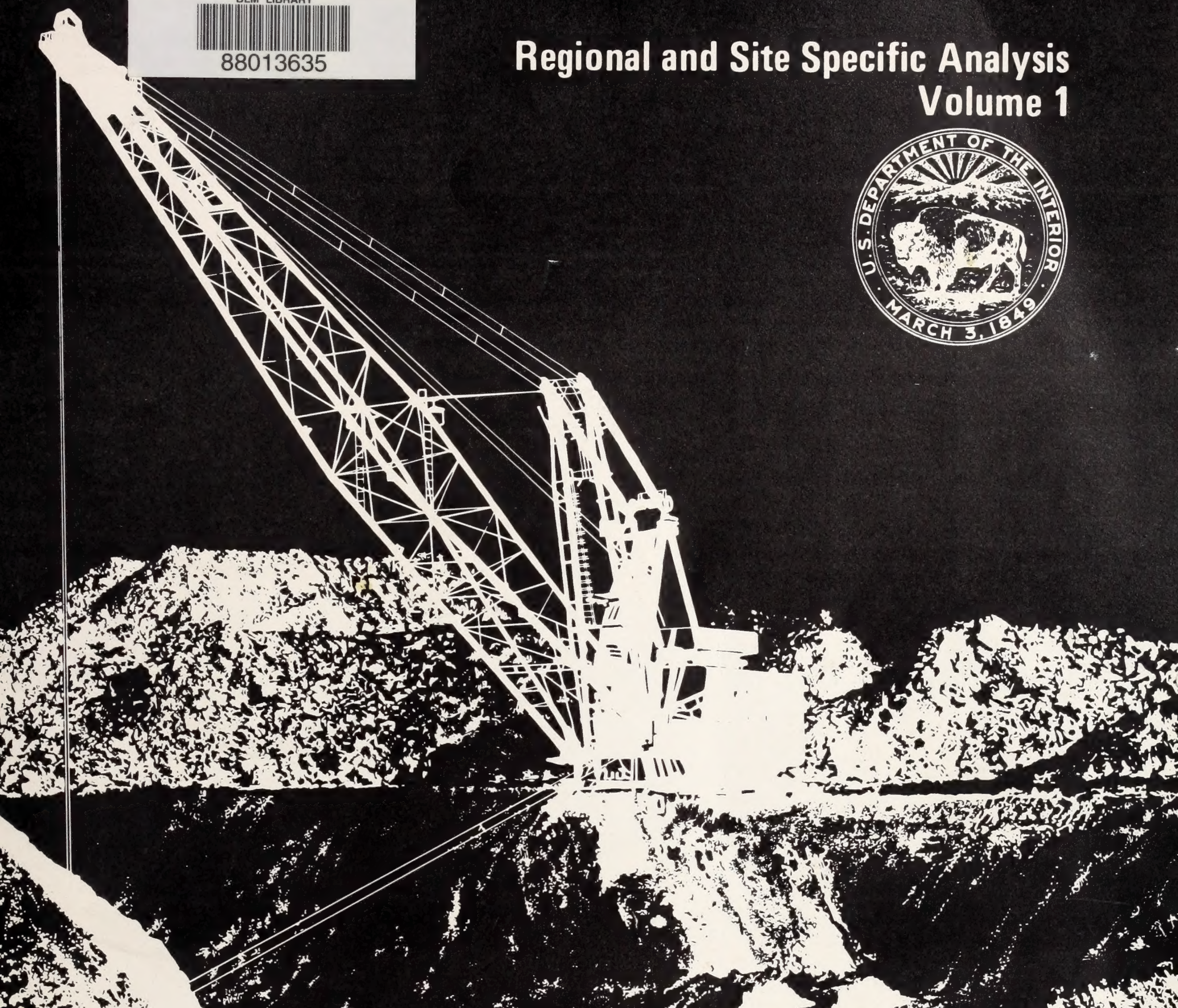

Regional and Site Specific Analysis
Volume 1

Rob's Control Copy

Draft

ENVIRONMENTAL STATEMENT

Development of Coal Resources in Southcentral Wyoming

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
State Office
P. O. Box 1828
Cheyenne, Wyoming 82001

IN REPLY REFER TO
1792 (920)

In the interest of reducing printing costs preparing environmental statements (ES) all or parts of this draft may be incorporated by reference into the final statement. If no major changes in the draft ES are necessary a printed supplement would then be substituted and mailed to all addressees. Please keep the draft text and maps in the event that the final ES is not totally reprinted.

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
State Office
P. O. Box 1828
Cheyenne, Wyoming 82001

IN REPLY REFER TO
1792 (920)

Dear Reviewer:

Enclosed for your review and comment is a copy of the Draft Environmental Statement for the Southcentral Coal Region of Wyoming.

The statement covers a site specific analysis for three proposed coal mines on existing leases, the rights-of-way necessary to develop these mines and a cumulative impact analysis upon the coal region.

The coal region consists of approximately 5.5 million acres and includes portions of Carbon and Sweetwater Counties.

We would appreciate receiving your written comments on the environmental statement no later than November 29, 1978, so they may be considered in preparation of the final environmental statement. All comments should be mailed to:

Team Leader
Coal ES Team
P.O. Box 670
Rawlins, WY 82301

DEPARTMENT OF THE INTERIOR

DRAFT

ENVIRONMENTAL STATEMENT

PROPOSED

DEVELOPMENT OF COAL RESOURCES

IN

SOUTHCENTRAL WYOMING

Prepared by the

DEPARTMENT OF THE INTERIOR

State Director, Wyoming State Office
Bureau of Land Management

SUMMARY

Draft (X) Final ( ) Environmental Statement

Department of the Interior, Bureau of Land Management

1. Type of Action: Administrative (X) Legislative ( )

2. Brief Description of Action: The proposed actions are based on three formal industry proposals for mining federal coal by 1980, 1985, and 1990. This environmental statement is developed in two parts: a regional analysis of cumulative impacts of potential coal development in the region and site specific mining and reclamation plan analyses. Involved are:

A. Approval of three mining and reclamation plans on existing leases.

B. Issuance of eleven rights-of-way for ancillary facilities related to the above, including one power line, one railroad spur, one telephone line, one access road, one haul road, one water pipeline, and one tailings pond; the relocations of a 230-kv power line, a 19.8-kv power line, a state highway, and a telephone line. Annual production estimates total 0.8 million tons by 1980, 5.6 million tons by 1985, and 6.0 million tons by 1990. Combined with existing mining expected to continue through 1990, a total of 17.8 million tons would be produced annually by that date.

3. Summary of Environmental Impacts by 1990:

A. Air quality would be lowered in terms of all presently regulated pollutants and visibility would be reduced. Maximum predicted concentrations of carbon monoxide, nitrogen oxides, sulfer dioxide, and hydrocarbons would be less than 10% of the federal and state standards.

B. Parts of some geologic formations would be disturbed, and also exposed for study. Some fossils would be destroyed, others would be revealed.

C. The natural contour of 5,904 acres would be modified; most would be returned to the original contour.

D. Existing soil profiles on 5,904 acres would be destroyed; soil productivity would be lowered until reclamation is completed.

E. Water use would be increased in the region by 910 acre feet per year by 1990. Some sediment loads may be reduced from existing levels.

F. By 1990, vegetation on 5,904 acres would be disturbed; 2,497 acres would be reclaimed; 550 acres would be utilized for permanent structures and developments; and the remainder (1,947 acres) would be utilized in an ongoing mine development or in a stage of reclamation.

G. Wildlife habitat and some populations would be lost or disrupted on 5,904 acres by 1990.

H. Some subsurface cultural resources could be destroyed.

I. The present visual quality would decrease as a result of mining, transpqration facilties, transmission lines, mine structures, and urban expansion.

J. The quality of outdoor recreation may decrease; urban recreation facilities would not meet the needs of increased population.

K. A total of 3,000 AUMs of forage would be lost by 1990.

L. Some 203.9 million tons of coal would be extracted; 46.1 million tons due to the proposed actions.

M. Mining would occur within zoned scenic corridors along highways.

N. Social support facilities would not keep pace with population increases. Small towns would lose their small town atmosphere. A total of 612 new jobs due to the proposed actions would reduce unemployment, but lead to a population increase. Population in the region would increase by 1,362 as a result of the proposed actions. Increased construction wages and investment would increase personal income, retail sales, and property values, but the inflationary pressures would result in hardship to persons on fixed incomes. All transportation arteries including rail lines would experience heavier average daily traffic loading. Some traffic delays would occur where coal haulage trucks cross secondary roads.

4. Alternatives Considered:

Three levels of development are assessed in the regional portion of this environmental statement. The most probable or mid level is made up of the three proposed actions. In addition, two scenarios are presented; a low scenario, based on no further federal action, and a high scenario, based on possible future developments in projected areas of interest.

5. Comments on the draft environmental statement have been requested from various agencies and state Clearing houses (See Attachment A).

6. Date Draft Statement was made available to EPA and the Public: October 13, 1978.

Attachment A

COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

Comments on the draft environmental statement will be requested from the following agencies and state clearing houses.

Federal

Advisory Council on Historic Preservation
Department of Agriculture
    Soil Conservation Service
    Forest Service
Department of Commerce
Department of Energy
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
    Bureau of Mines
    Bureau of Reclamation
    Fish and Wildlife Service
    Heritage Conservation and Recreation Service
    National Park Service
    Office of Surface Mining
Department of Labor
    Mining Safety and Health Administration
    Occupational Safety and Health Administration
Department of Transportation
Environmental Protection Agency
Federal Protection Agency
Federal Energy Regulatory Commission
Interstate Commerce Commission
Mountain Plains Federal Regional Council
National Historic Preservation Council
Office of Economic Opportunity
Office of Management and Budget
Water Resources Council

State

The State of Wyoming Clearing House will coordinate comments from all interested agencies.

Local

Carbon County Commissioners
Carbon County Council of Governments
Sweetwater County Commissioners
Sweetwater County Zoning and Planning Commission
City of Rawlins
Town of Hanna
Town of Saratoga
Town of Baggs
Town of Encampment
Town of Sinclair
Town of Wamsutter
Town of Medicine Bow

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FOR

SOUTHCENTRAL COAL ENVIRONMENTAL

STATEMENT

SEMINOE I

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SEMINOE I

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

BACKGROUND

The scope of the regional assessment includes the cumulative impacts of three mining and reclamation plans proposed for federal approval and the continuance of six existing mines, together with impacts resulting from other developments occurring or expected to occur within the Southcentral Wyoming Environmental Statement (ES) region. It assesses the impacts of federal and related state and private actions that, if fully implemented or adopted as discussed herein, could lead to the production of an additional 6.0 million tons of coal per year by 1990 from the region. (Total regional production would then be 17.8 million tons—6.0 due to the proposed actions and 11.8 from existing mines.) Regional impacts are assessed at three points in time (1980, 1985, and 1990).

The ES region is defined as the principal impact area of the coal-related developments analyzed in this environmental statement (see Figure R1-1). The region consists of approximately 5.5 million acres, and includes a major portion of the Green River coal region and the Hanna coal field. It covers parts of Sweetwater and Carbon Counties in southcentral Wyoming and a small portion of Routt and Moffat Counties in northwest Colorado. The principal communities are Rawlins, Hanna, Medicine Bow, Sinclair, Baggs, Savery, Elk Mountain, Encampment, Wamsutter, and Saratoga, all in Wyoming. The ES regional boundaries conform generally to the land use planning area boundaries for the Overland Unit and Hanna Unit Management Framework Plans (MFPs) within the Rawlins District of the Bureau of Land Management (BLM). Copies of these MFPs may be reviewed at the District Office and brochures summarizing these plans are available upon request.

Those impacts which extend beyond the principal ES region are analyzed to the extent that they are significant and are more associated with the proposed actions than with other actions outside the region. Elements having a broader geographic impact include social and economic factors, air quality, and transportation systems.

This ES was prepared by BLM (as lead agency) in cooperation with the Geological Survey (GS); support was provided by the U.S. Fish and Wildlife Service and the Bureau of Mines.

The statement does not propose new coal leasing nor does it commit the Secretary of Interior to a new coal-leasing program or the issuance of new coal leases.

The mining and reclamation plans included in this statement were submitted for review during or prior to promulgation of the initial regulations (30 CFR 700) required under Section 502 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87) and have not been officially reviewed for compliance therewith. Therefore, the applicants' plans may not fully reflect the requirements of the initial regulations. However, in this statement the initial regulations are considered as required federal mitigating measures the same as all other applicable regulations.

The mining and reclamation plans will be returned to the operator for revision in accordance with the applicable initial regulations. As soon as the applicants' plans are revised and returned to GS they will be evaluated with the Office of Surface Mining to determine compliance with the requirements of Federal Regulations at 30 CFR 211 and 30 CFR 700. The mining and reclamation plans cannot be approved until they conform to all applicable federal requirements.

Future National Environmental Policy Act (NEPA) Review Points

Future coal-related actions beyond those proposed and analyzed in this statement may require additional assessment of environmental impacts. Such future actions may include:

1. mine and reclamation plan approval;
2. mine and reclamation plan modifications for existing operations. Specifically, existing mines must modify their mining and reclamation plans to come into compliance with the Surface Mining Control and Reclamation Act;
3. issuance of coal exploration licenses;
4. future proposals for short-term development of unleased federal coal;
5. replacement (exchange) of unleased federal coal for leased federal
coal in areas of high environmental cost;
6. further federal authorizations for transportation and communication rights-of-way or other mine-related facilities; and
7. permit and/or lease readjustments. Terms and conditions of federal coal leases are readjusted every 20 years, while mining permits must be renewed every 5 years, under conditions of the Surface Mining Control and Reclamation Act.

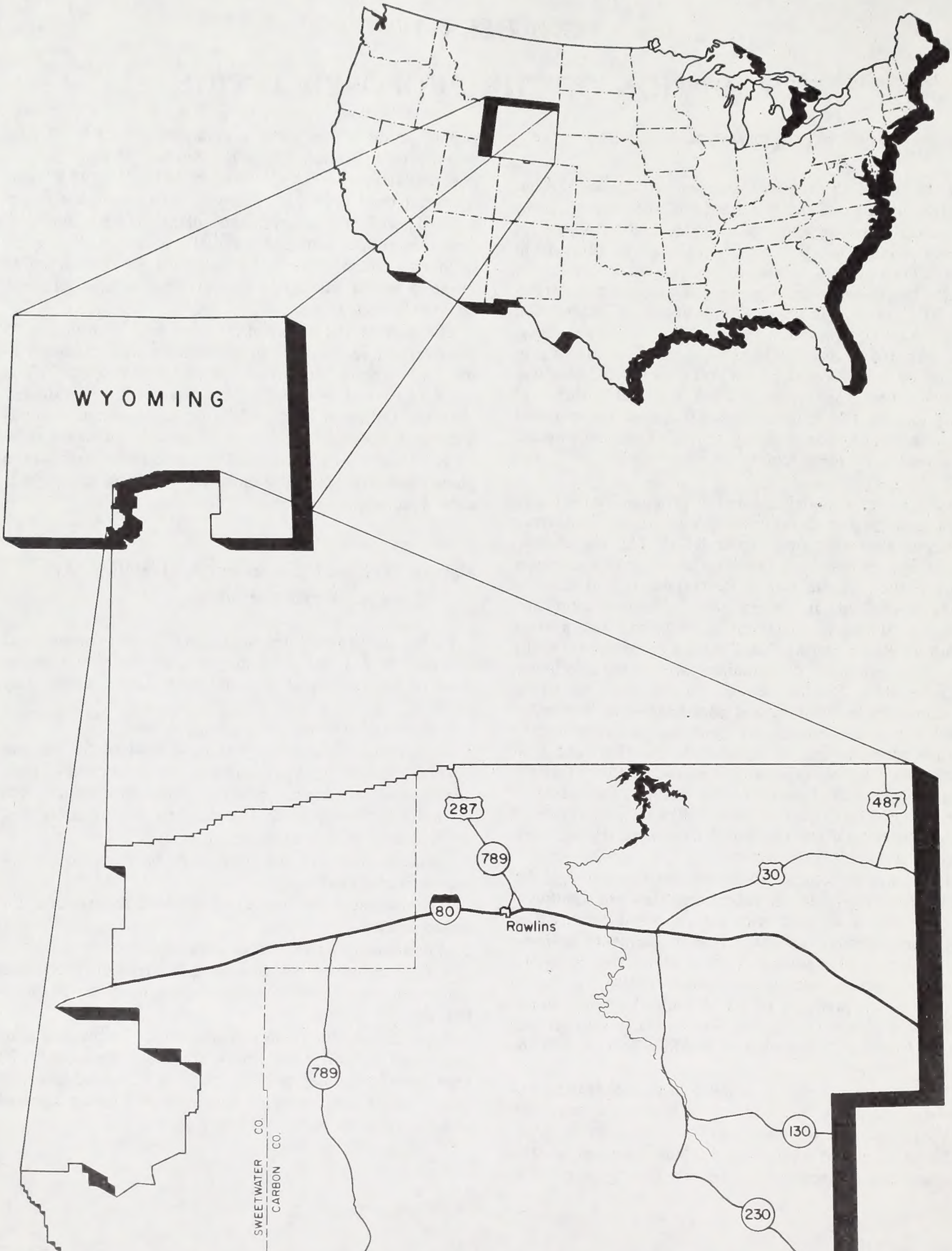


Figure R1-1

GENERAL LOCATION OF E.S. REGION

Related-Reviews

Preference Right Lease Application Status Review

Recent interpretation of the Mineral Leasing Act of 1920 has determined that areas of federal coal under preference right lease application cannot be leased if there exists, on that area, a prior (earlier) valid existing mining claim under the Mining Act of 1872. Preference right lease applicants are required to submit abstracts of any mining claims on their application by March 1978.

Preference right lease applicants were required to prepare initial showings indicating evidence of commercial quantities of coal. Initial showings were submitted by July 1977. They will be evaluated in technical reports and environmental assessments to be prepared jointly by BLM and GS.

On September 27, 1977, the Department of Interior was enjoined from issuing any new coal leases until a supplemental coal programmatic environmental statement correcting the deficiencies of the original statement has been issued in final form and a new coal management program has been developed. Therefore, the existing preference right lease applications cannot be considered until this injunction is lifted.

Department of Energy (DOE)

Under the Act of 1977, DOE was authorized to set coal production rates on federal coal leases, review and concur on stipulations included in federal coal leases, and establish diligence requirements for development of each lease. Guidelines and procedures are being developed for coordination of DOE's responsibilities with those of the Department of the Interior.

PROPOSED ACTIONS

The proposed actions are to consider for approval three coal mining and reclamation plans and the issuance of rights-of-way necessary to develop these proposed coal mines. Table R1-1 summarizes the proposed actions.

Approve Mining and Reclamation Plans

GS has accepted mining and reclamation plans for impact analysis on three proposals filed under 30 CFR 211 (Cherokee, Hanna South, Seminoe I) which would involve development of issued federal leases. Surface ownership on the three proposals includes 5,511 acres of public land; 12,487 acres of private; and 640 acres of state land; totaling 18,638 project acres (see Map 1 in Appendix A). For more detailed data, see Table R1-2. The proposed mines are in the checkerboard area of public, state, and private land along the Union Pacific Railroad. Coordinated development of the federal and other coal would be required to insure the maximum recovery of the coal resource.

The Cherokee Mine proposal was submitted by Pacific Power and Light Company in November 1976. The proposal would involve a surface coal mining operation on federal lease numbers W-092140, W-092141, W-0312917, and W-0313559.

In January 1978, Arch Mineral Corporation submitted the Hanna South Mine proposal which would involve a surface truck-and-shovel mine on federal lease W-25406.

Arch Mineral also submitted the Seminoe I Mine amendment proposal in January 1978, involving continuation of an existing surface coal operation on federal lease W-16465. Complete descriptions of these proposals may be found in the appropriate site specific sections.

Issue Rights-of-Way

Rights-of-way to cross public lands would be necessary for construction of power lines, railroad spur line, telephone line, access roads, haul road, a drainage control dam, and a water pipeline, all of which are included in the site-specific analyses of the three proposed mining and reclamation plans listed above. Table R1-1 identifies and quantifies these support developments. Other rights-of-way would be required for relocations of power lines, a telephone line, and a highway.

REQUIRED AUTHORIZATIONS

Federal

Assistant Secretary of Energy and Minerals

The Assistant Secretary shall approve the mining permit application and significant modifications or amendments thereto prior to commencement of mining operations by the company. The mining permit application includes the proposed mining and reclamation plan.

Office of Surface Mining (OSM)

OSM, with concurrence of the surface managing agency (BLM) and GS, recommends approval or disapproval of a mining and reclamation plan to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a cooperative agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regularoty authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and department authorized to take final actions on the permit.

Table R1-1

PROPOSED ACTIONS - SOUTHCENTRAL WYOMING

Map Ref	Name	Type of Mine*	Total Project Acres**	Production By 1990 MM Tons/Year	Mine Life (years)	Type	Miles Total	Miles Fed.	Acres Total	Acres Fed.
	MINE AND RECLAMATION PLAN APPROVALS					RIGHT-OF-WAY APPROVALS**** (To End of Project Life)				
CH	Cherokee	S	10,671	6.0	40	Access Road	1.0	.3	12.6	3.2
						Haul Road	.6	.6	7.8	7.8
						Railroad Spur	6.2	2.9	150	69
						Power Line (115-kv)	33.4	15.4	405	187
						Telephone (within access road ROW)	0	0	0	0
						Water - pipeline	3.4	2.8	20.8	16.8
						Relocation-Highway 789	6.7	2.9	163	69
						Relocations - 230-kv power line	8.5	3.2	154	59
						19.8-kv power line	6.9	2.7	42	16
						Relocation - telephone line	2	1	4	2
HS	Hanna South	S	4,127	0***	10	Drainage Control Dam	0	0	11	11
SI	Seminoe I	S	3,840	0***	4	No new right's of way				
						Total			970.2	440.8
	TOTALS		18,638	6.0						

* S = Surface Mine
** Includes federal, state, and private ownership
*** See Table R1-2
**** Right-of-way acreages will differ from disturbed acreages for the same facility, since the ROW figures are what would be covered by the permit, not what would actually be used.

Table R1-2

MOST PROBABLE LEVEL OF DEVELOPMENT OF EXISTING AND PROPOSED MINES IN SOUTHCENTRAL WYOMING BY 1990

Map Reference	Names	Mining Method[1]	Total[2] Recoverable Reserves MM Tons	Annual Coal Production (MM Tons/Year) 1977	1980	1985	1990
	Proposed Federal Actions (3)						
CH	Cherokee	S	250.0	0.0	0.0	5.0	6.0
HS	Hanna South	S	6.1	0.0	0.8	0.6	0.0
SI	Seminoe I	S	5.2	0.0	(1.3)[3]	(1.3)[3]	0.0
	SUBTOTAL		261.3	0.0	0.8	5.6	6.0
	Existing Mines (6)						
CC	Carbon County	U	132.5	0.0	1.5	2.0	2.5
MB	Medicine Bow	S	37.5	2.5	2.5	2.5	2.5
RB	Rosebud	S	36.4	2.0	2.0	2.0	2.0
SI	Seminoe I	S	27.0	2.3	2.3	2.3	0.0
SII	Seminoe II	S	39.5	3.0	3.5	3.5	3.5
VR	Vanguard - Rimrock	S/U	21.0	0.4	1.3	1.3	1.3
	SUBTOTAL		293.9	10.2	13.1	13.6	11.8
	TOTAL		555.2	10.2	13.9	19.2	17.8

[1] S = Surface, U = Underground

[2] Total recoverable reserves obtained from company estimates

[3] Figure in parentheses is included in total for existing mine

Table R1-2
(Continued)

MOST PROBABLE LEVEL OF DEVELOPMENT OF EXISTING AND
PROPOSED MINES IN SOUTHCENTRAL WYOMING BY 1990

		TIME FRAME			ACRES			
Map Reference	Names	Start Const.	Full Mine Operation	Mine Life (Years Remaining)	Total Project Acres[4]	Federal Lease Acres	Total Surface Acres to be Mined[5]	Average Total Acres Disturbed Per Year
	Proposed Federal Actions (3)							
CH	Cherokee	1982	1984	40	10,671	4,271	1,237	209
HS	Hanna South	1979	1979	10	4,127	640	464	83
SI	Seminoe I	1979	1979	4	3,840	960	734	365
	SUBTOTAL				18,638	5,871	2,435	657
	Existing Mines (6)							
CC	Carbon County	1978	1980	20[6]	10,240	1,920	7	7
MB	Medicine Bow	1972	1974	10	10,656	1,280	2,500	150
RB	Rosebud	1961	1963	15	13,120	1,193	2,390	175
SI	Seminoe I	1971	1973	8	14,660	6,340	2,035	300
SII	Seminoe II	1972	1974	11	6,323	3,113	1,562	130
VR	Vanguard - Rimrock	1970	1972	22	14,930	8,680	600	100
	SUBTOTAL				69,929	22,526	9,087	855
	TOTAL				88,567	28,397	11,522	1,512

[4] Includes federal, state, and private

[5] Includes mine and on-site haul roads

[6] Years remaining in presently approved mining and reclamation plans.

[7] Underground mine--yearly surface disturbance would be minimal.
A total of 200 surface acres would be disturbed during mine life.

Table R1-2
(Continued)

MOST PROBABLE LEVEL OF DEVELOPMENT OF EXISTING AND
PROPOSED MINES IN SOUTHCENTRAL WYOMING BY 1990

Map Reference	Names	EMPLOYMENT 1980 Const.	1980 Perm.	1985 Const.	1985 Perm.	1990 Const.	1990 Perm.	Estimated Number Of Trains And Direction of Market[8] 1980	1985	1990	Market Area
	Proposed Actions (3)										
CH	Cherokee	0	0	200	285	0	285	0	500E	600E	Midwest
HS	Hanna South	20	100	0	100	0	100	80E	60E	0	At Hanna-Energy Development[9]
SI	Seminoe I	0	25	0	25	0	0	0[10]	0	0	Midwest
	SUBTOTAL	20	125	200	410	0	385	80E	560E	600E	
	Existing Mines (6)										
CC	Carbon County		300		400		500	150E	200E	50W/200E	Georgia - Nevada
MB	Medicine Bow		160		160		160	250E	250E	250E	Midwest
RB	Rosebud		180		180		180	200E	200E	200E	Midwest
SI	Seminoe I		176		176		0	230E	230E	0	Midwest
SII	Seminoe II		145		145		145	350E	350E	350E	Midwest
VR	Vanguard - Rimrock		325		325		325	130E	130E	130E	Midwest
	SUBTOTAL		1,286		1,386		1,310	1,310E	1,360E	50W/1,130E	
	TOTAL	20	1,411	200	1,796	0	1,595	1,390E	2,020E	50W/1,730E	

[8] Assumes one unit train equals 100 cars, each train having a capacity of 10,000 tons of coal. Does not include return traffic.

[9] It is assumed that Energy Development would ship the coal to Midwest utilities.

[10] Included in existing.

Bureau of Land Management (BLM)

The BLM developes the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources other than coal and the postmining land use of the affected lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

Geological Survey (GS)

GS is responsible for development, production, and coal resource recovery requirements included in the mining permit.

State and County

State of Wyoming

Wyoming Department of Environmental Quality (DEQ). Whenever Wyoming enters into a cooperative agreement with the Secretary of the Interior pursuant to section 523(c) of SMCRA, DEQ and OSM will jointly review and act on mining and reclamation plans and permits to mines authorized under a federal coal lease. DEQ has authority relating to air quality, solid wastes, water quality, and mining and mined-land reclamation. The Land Quality Division issues permits and licenses to mine upon approval of a mining and reclamation plan. Mined-land reclamation provisions of the mining and reclamation plan are administered and enforced by the Land Quality Division. The Air Quality Division issues permits to construct and operate crushers or other point sources of air pollutants after approval of applications with regard to plans for monitoring and controlling air contaminants. The Water Quality Division issues permits to construct waste water systems. They also issue National Pollutant Discharge Elimination System (NPDES) permits for discharging waste water. The Solid Waste Division issues construction permits and industrial waste facility permits for solid waste disposal during construction and operation of coal mines.

Commissioner of Public Lands. Utility lines, roads, and railroad spurs crossing state land would require easements from the Commissioner of Public Lands (Wyoming Statutes 36-7).

Wyoming Highway Department. Relocation of highways and all utility line crossings of state and federal aid highways would require authorization from the Wyoming Highway Department.

Wyoming State Engineer. Any storage, impoundment, use of surface or groundwater for mining and coal processing operations would require a permit from the State Engineer. Water pipelines and diversion structures that could affect another user would also require a permit from the State Engineer.

Carbon County

Carbon County requires special use permits for mining activities within designated scenic corridors. That part of the proposed Cherokee Mine within the scenic corridor of State Highway 789 would require a special use permit. The proposed Hanna South Mine within the scenic corridors of Highway 30 and State Highway 72 would require special use permits.

Sweetwater County

That part of the proposed Cherokee Mine in Sweetwater County would require a zoning variance approval from the Sweetwater County Planning Commission. A construction permit from the county would also be required.

REGIONAL DEVELOPMENT SUMMARY

Coal Development

Three levels of coal development are assessed in this regional ES (see Figure R1-2). An assessment of the most current probable level of coal development is presented in the impact analysis of the proposed actions (Chapter 4). The descriptions and analyses of the low and high development levels and a comparison of these with the most probable level of development are presented in Chapter 8 (see Table R8-1).

The most probable level of coal development consists of production from the three proposed mines whose approvals constitute the proposed actions, together with continuation of production from existing mines (see Table R1-2).

Other Major Regional Development

Oil and Gas

Oil and gas production was recorded from 40 different fields in southcentral Wyoming in 1976. The ES area produced approximately .6% of the 134 million barrels of oil produced in the state of Wyoming in 1976. It also produced 9% of the 330 million cubic feet of natural gas produced in that year.

Employment in the oil and gas industry was approximately 1,200 people in 1976. This number is expected to remain stable through 1990.

New starts in oil and gas exploration and drilling increased by 30% in southcentral Wyoming during 1976 and are expected to further increase through 1990. This should result in discovery of more oil and gas fields and producing zones. With currently producing fields, discovery of new fields through exploration, and the anticipated development of new and better recovery methods, oil and gas operations in southcentral Wyoming should

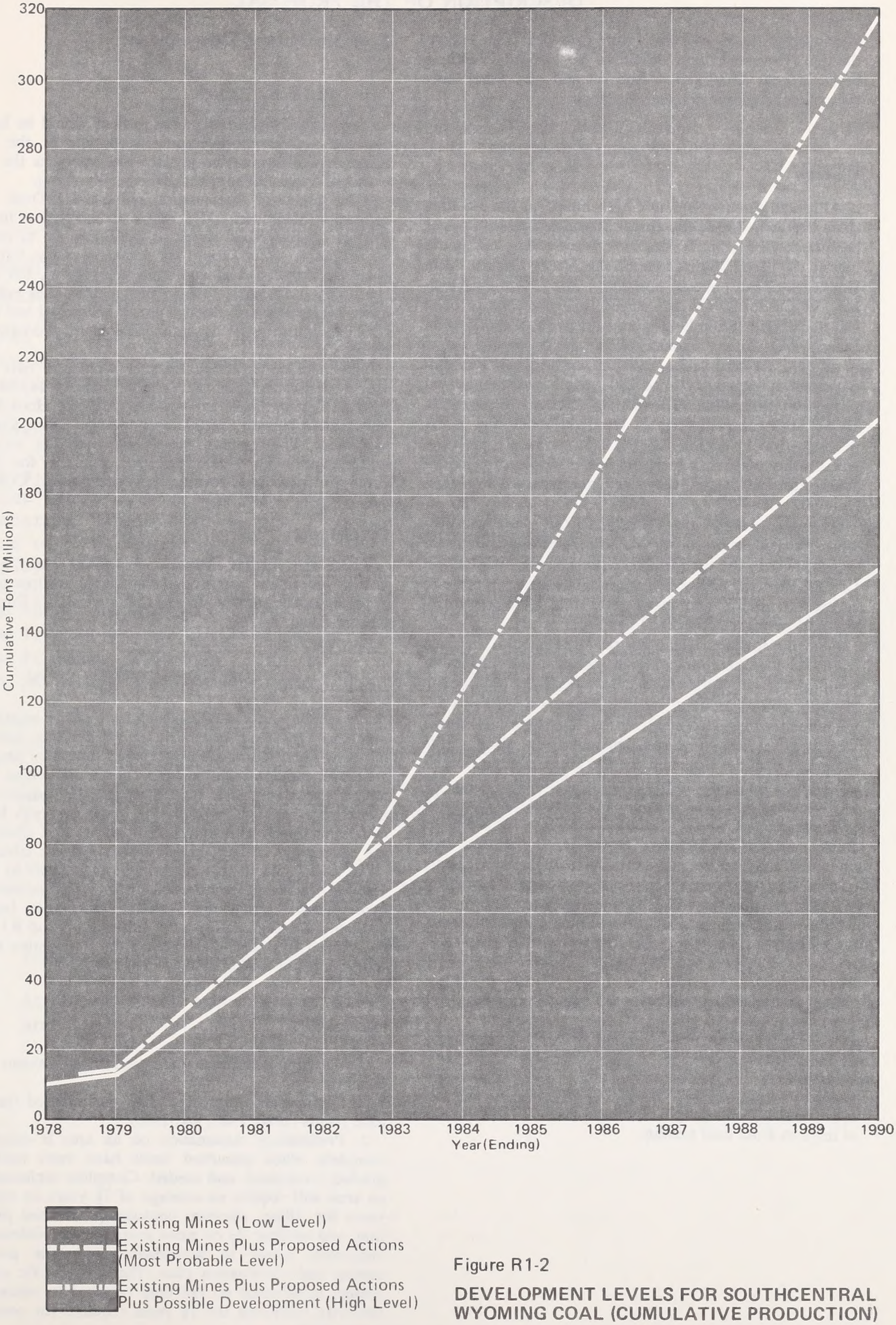


Figure R1-2

DEVELOPMENT LEVELS FOR SOUTHCENTRAL WYOMING COAL (CUMULATIVE PRODUCTION)

continue for the foreseeable future (see Map 3 in Appendix A). However, there should be no resource conflicts between coal development and oil and gas, other than the general regional demand for labor.

Uranium

Although uranium has not been mined in the ES area since the early 1960s, the current trend of uranium prices has created a market favorable for recovering low grade ore in the Red Desert area of the Great Divide Basin just north of the regional boundary. The Union Oil Company of California has announced that it intends to open a surface mine and mill 43 miles northwest of Rawlins, in Sweetwater County. Construction on this project began in mid 1977; a completion date has not been set. Full employment is expected to be 290 people with an annual payroll of $4 million *(The Mining R*ecord, October 20, 1976). Socioeconomic impact from this operation is expected to occur within the ES area, primarily in Rawlins. Of the total work force, 10% are expected to live in Wamsutter and Jeffrey City; 90% are expected to live in Rawlins.

Several areas near the ES region (Red Desert—northwest, Shirley Basin—north) could see increased uranium activity within the time frame of the ES. Rawlins-Carbon County Planning Office figures indicate that the projected area uranium employment could total 1,775 (construction and permanent workers) by 1985.

Demand for a uranium work force would, in part, occur at the same time as the construction phases of some of the proposed mines in the southcentral region. Housing and community service demands due to this development would also occur during the same time frame that these services are being demanded as a result of the increased coal development. In the areas of actual uranium mining, there are no proposed coal developments.

Two other areas of possible uranium activity located in the southwest part of Carbon County are the Ketchum Buttes and the Baggs areas. However, at this time it is uncertain whether or not mining will resume. Based on past mining, the socioeconomic impact would be mostly in Colorado and the Baggs, Wyoming area. The project would not cause any resource conflicts with coal development other than the general demand for labor.

Other Construction Activities

A new Wyoming State Correctional Institute has been scheduled for completion in the immediate Rawlins area sometime in the early 1980s. The socioeconomic and work force impacts associated with this project will add approximately 360 people to the total cumulative regional impacts from coal mining.

Possible Future Development

Savery-Pot Hook Project

If approved and funded, the project would be located along the Colorado-Wyoming state line in the Little Snake River Basin. The project area includes the small towns of Baggs, Dixon, and Savery, Wyoming.

The Bureau of Reclamation published a Draft Environmental Statement (DES 76-37) on the project in 1976. Project objectives, as stated in the DES, are to provide an irrigation water supply for some presently, but inadequately irrigated land and some unirrigated, but arable land. Other objectives are to provide fisheries enhancement, recreation, and flood control. Municipal and industrial use of the water were considered as alternatives in the DES.

The main construction features would be two reservoirs--Sandstone Reservoir (active capacity 14,000 acre-feet) on Savery Creek in Wyoming and Pot Hook Reservoir (active capacity 26,000 acre-feet) on Slater Creek in Colorado. The project would increase the irrigation water supply by 44,000 acre-feet annually for 29,000 acres of project land located in Wyoming and Colorado.

Other Plans

There are current plans under way to study a wind power generation complex in the Medicine Bow area of Wyoming. The study will be conducted by the Bureau of Reclamation.

ASSESSMENT GUIDELINES

An assessment of regional impacts requires establishing guidelines for coal-related development. The following narratives and tables were developed, based on projected coal and ancillary developments for the ES region, to establish parameters and guidelines for the assessment of cumulative regional impacts. They are set forth here in order that the reader may follow causes and effects and the magnitude of anticipated impacts. These tables also make it possible for the assessment of impacts to be revised in the future, based on the actual development that takes place. As new development information becomes available, these guidelines and Tables R1-3 and R1-4 will be utilized to determine whether the cumulative magnitude of impact is increased or decreased.

Guidelines

The following guidelines were used for assessment of impacts:

1. Cumulative regional impacts are assessed for three time points (1980, 1985, and 1990).
2. Preliminary reclamation on an area is considered complete when disturbed lands have been backfilled, graded, contoured, and seeded. Complete reclamation of an area will require an average of 7½ years or more; 3 years for filling, shaping, contouring, seedbed preparation, and seeding; 4½ or more years for establishment of vegetative cover in accordance with the proposed mining and reclamation plan. The site specific analyses present predictions on the time required to restore productivity following the 7½ years required for complete reclamation.

Table R1-3

PROJECTED CUMULATIVE REGIONAL SURFACE ACRES TO BE DISTURBED AND RECLAIMED AND OTHER DEVELOPMENT DATA ON MINES INCLUDED IN THE PROPOSED ACTION

Activity or Project	Point of Analysis 1980	1985	1990
Final Contour[1] (Acres Disturbed)	677	3,138	4,605
Mine Facilities[2] (Acres Disturbed)	95	349	349
Ancillary Facilities[3] (Acres Disturbed)	19	400	400
Facility Relocation[4] (Acres Disturbed)	--	26	206
Housing and Support Facilities (Acres Disturbed)	95	344	344
Acres Reclaimed[5]	6	1,615	2,497
Water Use acft/yr (Noncumulative)	110	810	910
Number of Mines	2	3	3
Tons of Coal Produced	2	15	46
Employment Increase	145	610	385
New Power lines (Miles)	4	45	45
New Rail Spur (Miles)	--	8	8
New Telephone Line (Miles)	4	4	4
New Pipeline (Miles)	--	3	3
New Access Road (Miles)	4	9	9

[1] Includes mine pit area, haul roads, topsoil and overburden storage areas.

[2] Includes surface facilities, rail spur, access road, power lines, telephone lines and water storage areas inside project boundary.

[3] Includes access roads, haul roads, rail spur, power lines, telephone lines, pipelines, coal conveyor and water storage outside project boundary.

[4] Includes power lines, telephone line and Highway 789 relocation.

[5] Areas on which topsoil has been replaced and shaped, seedbed prepared and seeded.

Table R1-4

PROJECTED CUMULATIVE REGIONAL SURFACE ACRES TO BE DISTURBED AND RECLAIMED AND OTHER DEVELOPMENT DATA ON PROPOSED MINES, EXISTING MINES, AND NON-COAL RELATED ACTIVITIES.

Activity or Project	Point of Analysis		
	1980	1985	1990
Final Contour[1] (Acres Disturbed)	2,467	9,149	14,891
Mine Facilities[2] (Acres Disturbed)	126	395	410
Ancillary Facilities[3] (Acres Disturbed)	35	423	423
Facility Relocation[4] (Acres Disturbed)	--	26	206
Housing and Support Facilities (Acres Disturbed)	200	455	455
Non-Coal Related Disturbance[5] (Acres)	575	1,460	2,375
Acres Reclaimed[6]	2,016	8,705	13,452
Water Use ac ft/yr (Noncumulative)	223,770	251,360	296,120
Number Coal Mines	7	8	7
Tons of Coal Produced	28	109	204
Number Oil and Gas Wells[7]	298	353	408
Employment Increase	873	1,817	1,516
New Power lines (Miles)[7]	13	79	115
New Rail Spur[7]	3	11	11
New Pipelines (All Kinds)[7]	45	120	185
New Access Roads[7]	4	9	9

1 Includes mine pit area, haul roads, topsoil and overburden storage areas.

2 Includes surface facilities, rail spur, access road, power lines, telephone lines and water storage areas inside project boundary.

3 Includes access roads, haul road, rail spur, power lines, telephone lines, pipelines, coal conveyor and water storage outside project boundary.

4 Includes power line, telephone line and Highway 789 relocation.

5 Includes acres disturbed by oil and gas production, uranium, sand and gravel, prison construction, housing, support facilities, etc.

6 Areas on which topsoil has been replaced and shaped, seedbed prepared and seeded.

7 Future estimates based on past occurrences.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

The rugged terrain of the southcentral Wyoming ES region causes the climate to be highly variable throughout the region. The lower elevations of the region are semiarid with cold winters and mild summers. In the mountains, precipitation is more abundant; winters are cold, and summers are cool. In general, winds with a westerly component prevail. However, the prevailing wind direction at many sites within the region is strongly affected by the local topography. Southcentral Wyoming is in a part of the contiguous United States that has low potential for dispersion of atmospheric contaminants.

Additional climatological information is documented in the Chapter 2 Regional Technical Report available for review at the Rawlins District Office of the BLM.

General Climatic Characteristics

Temperature

Temperature variations across southcentral Wyoming are primarily dependent upon elevation and topography. Temperatures generally decrease with increase in elevation. Warm, downslope winds (chinooks) can occur on the eastern side of the Rocky Mountains at any time of the year, but are most noticeable during the winter.

The average (mean) temperature maxima and minima for January and July are presented in Table R2-1 for various stations in southcentral Wyoming. Because of the variation of topography, the temperatures at these locations can be used only as indicators of the normal temperature ranges for other portions of the ES region.

Growing Season

The growing season in southcentral Wyoming is primarily dependent on elevation and topography. Drainage basins (e.g., canyons and valleys) often experience colder nighttime temperatures than areas outside of the basins. Cold air drains from the mountain slopes into the basins on nights with clear skies and light winds or calm conditions. Therefore, these basins often have shorter growing seasons than adjacent areas.

The growing season temperature threshhold can vary with different plant species. The growing season with temperatures of 16°F or greater for five locations in southern Wyoming ranges from April to late October. The 32°F growing season typically lasts from late May or June to late August or early September (see Table R2-2).

Because of the large variation of the topography in southcentral Wyoming, some of the areas outside the towns listed in Table R2-2 are expected to have significantly different growing seasons. Even within an existing surface coal mine, the growing season may be variable.

Precipitation

Precipitation amounts vary significantly across southcentral Wyoming because of variations in topography and because much of the precipitation falls during thunderstorms. Although thunderstorms in the ES region often produce only small rainfall amounts, thunderstorms are sometimes locally heavy.

Isopleths of annual precipitation in the ES region are presented in Map R2-1. The totals shown include rainfall and melted snowfall. Isopleths of snowfall totals (unmelted) are shown in Map R2-2. Monthly and annual precipitation totals for several locations in or near the ES region are presented in Table R2-3.

Southcentral Wyoming can expect a drought one year in nine if the drought frequencies at Dixon, Rawlins, and Elk Mountain can be assumed as representative of the region. Dixon received less than 75% of its normal precipitation during 5 of the 53 years between 1923 and 1975, while Rawlins and Elk Mountain had less than 75% of their normal precipitation during 6 of the 53 years (U.S. Department of Commerce 1923 to 1975).

Air Moisture

The relative humidity in southcentral Wyoming averages about 50% in the summer and about 70% in the winter (U.S. Department of Commerce 1968). Summer afternoons often have humidities as low as 20%.

Fogs, infrequent in Rawlins, Wyoming, because of the small amount of atmospheric moisture generally available for condensation near the ground, restricted visibility to 7 miles or less on an average of 209 hours per year from 1955 to 1964. The highest frequency of fog occurs in the winter, while the lowest frequency occurs in the summer.

The evaporation rate in the ES region is higher than in most of the eastern United States, but not nearly as high as in the Southwest. The mean annual evaporation from lakes ranges from 36 to 42 inches. The class-A pan evap-

Table R2-1

MEAN MAXIMUM AND MEAN MINIMUM TEMPERATURES (^{o}F)

Station	July Maximum	July Minimum	January Maximum	January Minimum
Wamsutter	85	48	30	7
Rawlins	84	51	31	12
Dixon	83	46	32	3
Saratoga	83	48	32	8
Encampment	82	47	34	10
Medicine Bow	83	47	32	10
Centennial	76	47	32	12
Fox Park	71	37	26	4
Laramie	78	51	31	13

Data based on continuous records ranging from ten years (1951-1960) at Medicine Bow to 30 years (1931-1960) at Laramie (Becker and Alyea, 1964b).

Table R2-2

GROWING SEASON FOR SELECTED LOCATIONS IN OR NEAR THE

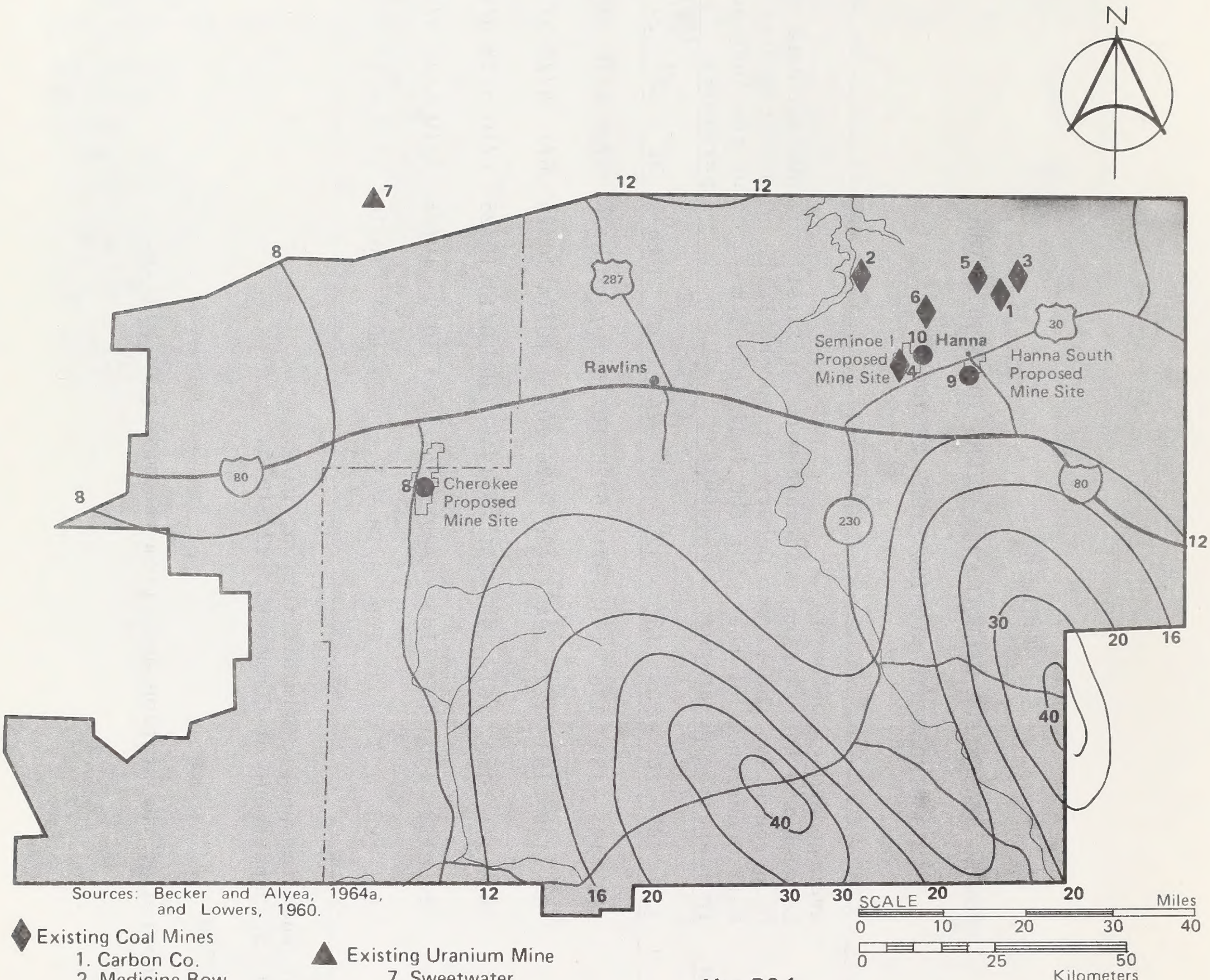
SOUTHCENTRAL WYOMING STUDY REGION

Station	Elevation	Average Number of Days Between the Last Spring Occurrence and the First Fall Occurrence of the Indicated Temperatures (°F)					Average Date of First Occurrence in the Fall of the Indicated Temperatures (°F)					Average Date of Last Occurrence in the Spring of the Indicated Temperatures (°F)				
	(feet)	32°	28°	24°	20°	16°	32°	28°	24°	20°	16°	32°	28°	24°	20°	16°
Laramie	7,211	113	135	159	176	193	9/19	9/28	10/10	10/20	10/26	5/29	5/16	5/4	4/27	4/16
Leo 6 SW*	6,000	84	129	153	172	194	8/30	9/26	10/3	10/14	10/24	6/7	5/20	5/3	4/25	4/13
Dixon	6,364	83	114	140	167	199	9/1	9/19	9/30	10/13	10/25	6/10	5/28	5/13	4/29	4/9
Saratoga	6,786	80	113	136	163	183	8/29	9/16	9/27	10/9	10/21	6/10	5/26	5/14	4/29	4/21
Marshall 7SW*	7,010	59	83	123	143	166	8/18	9/1	9/22	10/1	10/10	6/20	6/10	5/22	5/11	4/27

Source: National Oceanic and Atmospheric Administration, 1974.
Source for elevation: U. S. Department of Commerce, 1923-1975.

Period of record: 1921-1950.

*Number of miles and direction of the station away from the main post office.



Sources: Becker and Alyea, 1964a, and Lowers, 1960.

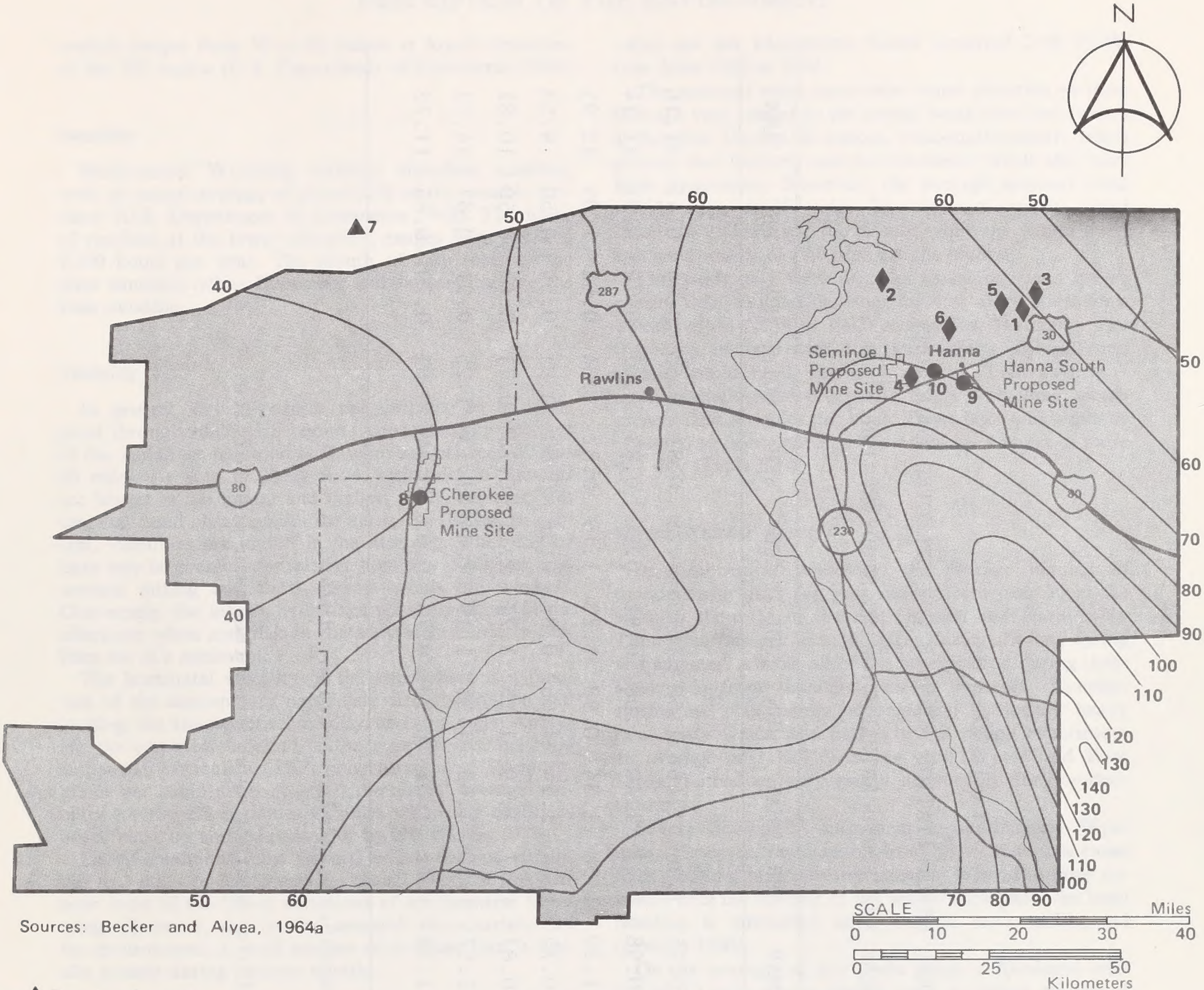
Existing Coal Mines
1. Carbon Co.
2. Medicine Bow
3. Rosebud
4. Seminoe I
5. Seminoe II
6. Vanguard/Rimrock

Existing Uranium Mine
7. Sweetwater

Proposed Coal Mines
8. Cherokee
9. Hanna South
10. Seminoe I Expansion

Map R2-1

MEAN ANNUAL PRECIPITATION IN THE SOUTHCENTRAL WYOMING STUDY REGION



Sources: Becker and Alyea, 1964a

♦ Existing Coal Mines
1. Carbon Co.
2. Medicine Bow
3. Rosebud
4. Seminoe I
5. Seminoe II
6. Vanguard/Rimrock

▲ Existing Uranium Mine
7. Sweetwater

● Proposed Coal Mine
8. Cherokee
9. Hanna South
10. Seminoe I Expansion

Map R2-2

MEAN ANNUAL SNOWFALL IN THE SOUTHCENTRAL WYOMING STUDY REGION

Table R2-3

MONTHLY AND ANNUAL PRECIPITATION NORMALS FOR SELECTED LOCATIONS

IN OR NEAR THE SOUTHCENTRAL WYOMING STUDY REGION

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Laramie	0.38	0.40	0.75	1.36	1.46	1.50	1.75	1.25	0.81	0.65	0.44	0.41	11.16
Leo 6 SW*	0.66	0.64	0.98	1.37	1.40	1.08	0.91	0.96	0.83	1.02	0.72	0.57	11.14
Dixon	0.93	0.69	1.20	1.36	1.34	0.98	1.23	1.19	0.82	1.34	0.82	1.05	12.95
Saratoga	0.47	0.41	0.73	1.04	1.24	1.06	0.87	0.96	0.80	0.91	0.54	0.50	9.53
Marshall 7SW*	0.63	0.56	0.87	1.17	1.49	1.25	1.27	1.11	0.78	0.71	0.47	0.50	10.81
Encampment 10 ESE*	0.86	0.81	1.57	1.80	1.65	1.35	1.19	1.34	1.13	1.25	0.91	0.87	14.73
Elk Mountain	0.75	0.90	1.38	1.71	1.31	0.93	0.73	0.92	0.94	0.81	0.70	0.64	11.72

Source: National Oceanic and Atmospheric Administration, 1974.

Period of record: 1931-1955.

*Number of miles and direction of the station away from the main post office.

oration ranges from 50 to 60 inches at lower elevations of the ES region (U.S. Department of Commerce 1968).

Sunshine

Southcentral Wyoming receives abundant sunshine, with an annual average of about 60% of the possible sunshine (U.S. Department of Commerce 1968). The hours of sunshine at the lower elevations ranges from 2,600 to 2,700 hours per year. The month of July receives the most sunshine, while December and January receive the least sunshine.

Visibility

In general, dry air causes the visibility to be quite good throughout the ES region. Approximately one-half of the visibilities recorded at Rawlins are between 30 and 60 miles. As seen in Table R2-4, visibilities at Rawlins are lowest in the winter and highest in the summer; this seasonal trend characterizes the entire ES region. In general, visibilities are lowest in the morning, when fog or haze may be present, the relative humidity is highest, and vertical mixing and the transport winds are weakest. Conversely, the highest visibilities normally occur in the afternoon when materials in the air which restrict visibilities are at a minimum.

The horizontal visibility of the atmosphere is a function of the atmospheric particulate size distribution and loading, the atmospheric humidity, and sun angle. Applying the empirical function to the regional baseline total suspended particulate (TSP) concentration of 31 micrograms per cubic meter ($\mu g/m^3$) the annual average visibility for the ES region is 47 miles where air quality is not affected by surface mining or by urban areas.

Dusty conditions (dust storms) which restrict visibilities to 7 miles or less occur less than 2 hours of the year over most of the lower elevations of southcentral Wyoming. However, due to the semiarid characteristics of the environment, a small amount of airborne dust is usually present during summer months.

Wind Patterns

Rawlins, Wyoming, has the only long-term wind speed and direction record in southcentral Wyoming. The annual wind rose for Rawlins (Figure R2-1) is approximately representative of many locations at lower elevations. However, because of the variations of the rugged terrain within the ES region, significant deviations from Rawlins' wind patterns can be expected in many other localities.

On an annual basis, the prevailing winds are from the west-southwest at Rawlins. West-southwesterly winds occurred 26% of the time from 1955 to 1964, and this wind direction had a high average wind speed of 16 miles per hour (mph). Westerly and southwesterly winds also have a high frequency. Despite the high wind speeds associated with many of the wind directions, calms are not uncommon. Calms occurred 21% of the time from 1955 to 1964.

The seasonal wind roses show wind direction patterns that are very similar to the annual wind direction pattern at Rawlins. During all seasons, west-southwesterly winds prevail, and westerly and southwesterly winds also have high frequencies. However, the average seasonal wind speeds vary significantly. The summer average wind speeds of 8.9 mph are the lowest, while the winter average wind speeds of 13.9 mph are the highest.

Thirty-one days were recorded as having wind speeds greater than 30 miles per hour for 4 or more hours for a 4-year period (1959 to 1963) at Rawlins, Wyoming. The frequency of days with 4 or more hours of high wind speeds would be 1 day in 3 months. Two days in 7 months would have 6 or more hours with wind speeds greater than 30 miles per hour. These high winds can be expected to occur once in 10 months for 8 hours or more in 1 day (Table R2-5).

Severe Weather Events

In southcentral Wyoming, the average number of thunderstorm days per year ranges from near 30 in the west to about 35 in the east (Bryson and Hare 1974). Thunderstorms are most frequent during the late spring and summer. Almost all of the precipitation during these seasons is from thunderstorms or showers. Thunderstorms are occasionally accompanied by locally heavy rain, gusty winds, and hail. The ES region experiences an average of 3 hail days per year (Bryson and Hare 1974). Tornadoes very rarely accompany the thunderstorms.

Severe flooding is infrequent in southcentral Wyoming. However, rapid runoff from heavy rains can cause flash flooding in headwater streams. When the rains coincide with the melting of the winter snowpack, the local flooding is intensified and becomes more widespread (Lowers 1960).

On the average, at any given point, a 30-minute rainfall of 0.3 inch occurs once a year. A 2-hour rainfall of 2.0 inches is expected only once every 100 years (Hershfield 1961).

Snowfalls are frequent throughout southcentral Wyoming from November to April. Outside the mountains, single snow storms of greater than 10 to 15 inches are infrequent (Lowers 1960). Ground blizzards are caused by severe blowing and drifting snow and reduce surface visibilities to near zero, even when no snow is falling and the sky is clear.

In general, fastest mile (or "extreme mile") wind of 60 miles per hour can be expected once every 2 years, whereas a fastest mile wind of 95 miles per hour can be expected once every 100 years. These extreme winds are often associated with local severe thunderstorms. Sometimes, they are caused by strong low-pressure systems (extratropical cyclones).

Table R2-4

ANNUAL AND SEASONAL HORIZONTAL

VISIBILITIES (MILES) AT RAWLINS, WYOMING

Season	Average Horizontal Visibility (Miles)
December, January, February	22.5
March, April, May	26.4
June, July, August	31.8
September, October, November	26.4
Annual	26.8

Source: National Climatic Center, 1955-1964.

Table R2-5

DAYS WITH WIND SPEEDS GREATER THAN 30 MILES

PER HOUR RECORDED AT RAWLINS, WYOMING [1]

Lower Limit of Number of Hours Per Day	Number of Days in Meteorological Record	Relative Frequency (days per month)
4	31	.646
6	13	.271
8	5	.104

[1] Source: National Climatic Center.

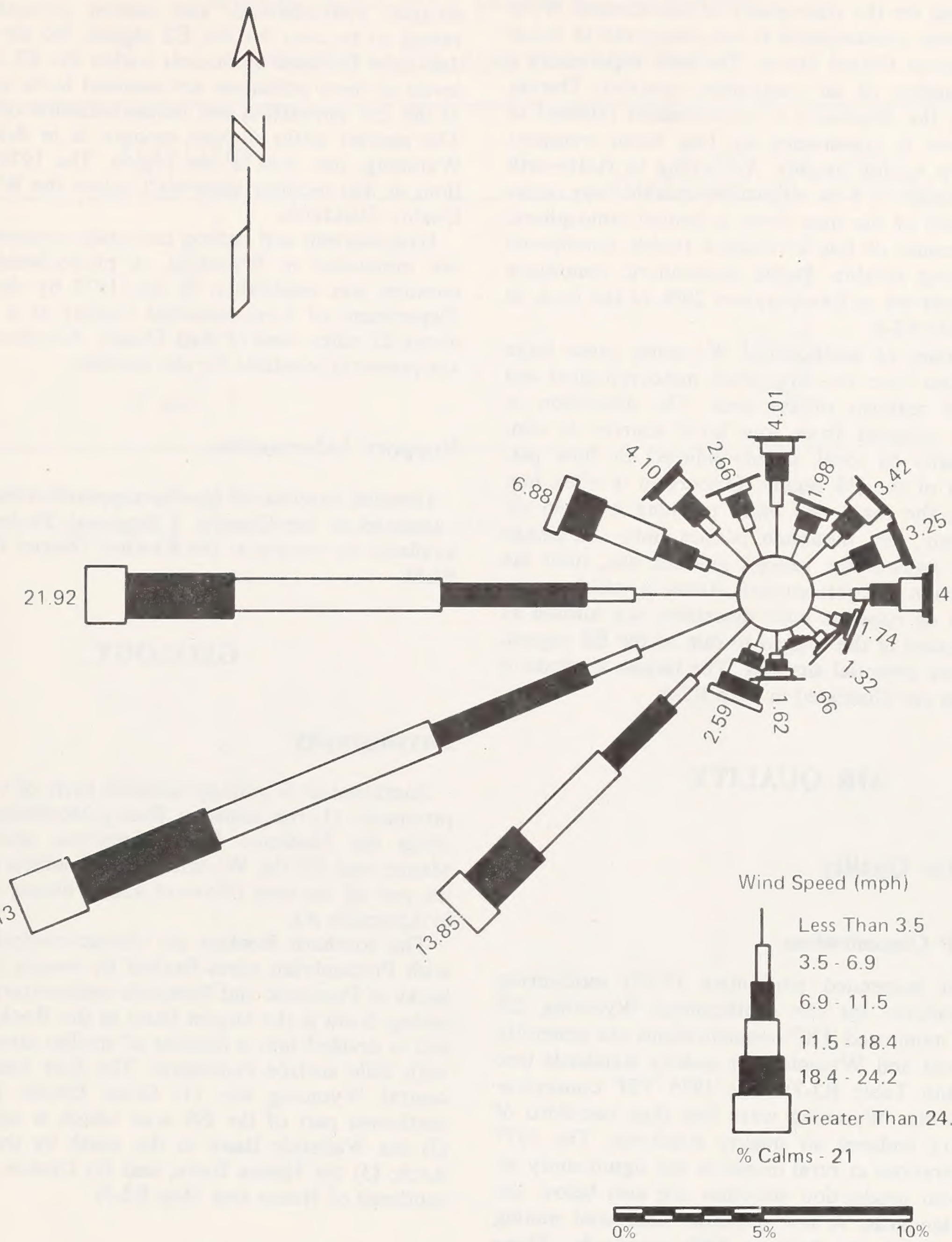


Figure R2 - 1

ANNUAL WIND ROSE FOR RAWLINS, WYOMING, 1955 - 1964

Sources: National Climatic Center, 1968.
Nation Climatic Center, 1955-1964.

Atmospheric Dispersion Potential

The potential for the atmosphere of southcentral Wyoming to disperse contaminants is low compared to much of the contiguous United States. The area experiences a significant number of air stagnation episodes. During these periods, the dispersion of contaminants released to the atmosphere is constrained by low mean transport winds and low mixing heights. According to Holzworth (1972), an average of 4 air stagnation episode days occur per year. Much of the time there is limited atmospheric dispersion because of low turbulence (stable conditions) and low mixing heights. Stable atmospheric conditions have been observed at Rawlins over 28% of the time, as shown in Table R2-6.

The mountains of southcentral Wyoming cause large local deviations from the large-scale meteorological and climatological patterns of the area. The dispersion of contaminants released from low level sources is controlled primarily by local, terrain-induced air flow patterns in most of the ES region. Dispersion is often hindered during the night and early morning by cold air flowing down the mountain slopes into "drainage basins". The walls of the valleys, gulches, etc., limit the lateral dispersion of contaminants. Areas in which steep-sided valleys or canyons limit dispersion are known as airsheds. Because of the rugged terrain of the ES region, many areas are potential airsheds. The largest airsheds in the ES region are illustrated in Map R2-3.

AIR QUALITY

Ambient Air Quality

Baseline TSP Concentrations

Only total suspended particulate (TSP) monitoring data are available for the southcentral Wyoming ES region. The monitored TSP concentrations are generally below national and Wyoming air quality standards (see Map R2-4 and Table R2-7). The 1976 TSP concentrations in Rawlins, Wyoming were less than one-third of the secondary ambient air quality standards. The 1977 TSP concentrations at rural monitors not significantly affected by coal production activities are also below the secondary standards. A few monitors near coal mining operations exceed the 24-hour TSP standards. These only reflect the air quality of the specific site because the concentrations reflect fugitive dust which falls out of the air within several miles. They are not truly representative of the regional air quality.

The annual baseline concentration for TSP is expected to be about 31 $\mu g/m^3$. The baseline concentration is calculated from air quality data measured at the lower elevations and is anticipated to be representative of the baseline air quality in the large basins of the region.

Baseline Concentrations of Gaseous Pollutants

The baseline concentrations of sulfur dioxide, nitrogen dioxide, hydrocarbons, and carbon monoxide are assumed to be zero for the ES region. No air monitoring data exist for these pollutants within the ES region. The levels of these pollutants are assumed to be zero because of the low population and industrialization of the region. The nearest sulfur dioxide monitor is in Rock Springs, Wyoming, just west of the region. The 1976 concentrations at that monitor were well below the Wyoming Air Quality Standards.

Hydrocarbon and carbon monoxide concentrations are not monitored in Wyoming. A photochemical oxidant monitor was established in late 1977 by the Wyoming Department of Environmental Quality at a remote site about 25 miles west of Red Desert. No monitoring data are presently available for the monitor.

Support Information

Detailed baseline air quality support information is documented in the Chapter 2 Regional Technical Report available for review at the Rawlins District Office of the BLM.

GEOLOGY

Physiography

Southcentral Wyoming includes parts of two geologic provinces: (1) the southern Rocky Mountains, which include the Medicine Bow Mountains and the Sierra Madre; and (2) the Wyoming Basin, which encompasses the rest of the area (Howard and Williams 1972, Map 4 in Appendix A).

The southern Rockies are characteristically anticlinal with Precambrian cores flanked by steeply dipping hogbacks of Paleozoic and Mesozoic sedimentary rocks. Wyoming Basin is the largest basin in the Rocky Mountains and is divided into a number of smaller structural basins with little surface expression. The four basins in southcentral Wyoming are: (1) Great Divide Basin in the northwest part of the ES area which is separated from (2) the Washakie Basin to the south by the Wamsutter Arch; (3) the Hanna Basin; and (4) Carbon Basin to the southeast of Hanna (see Map R2-5).

Major Structures

The tectonic map (Map R2-5) shows the southcentral coal ES region and its mountain uplifts, basins, major anticlines, synclines, and faults, and most of the oil and gas fields. The spacing of the structure contours indicates the amount of dip on the Lower Cretaceous Cloverly Formation contour horizon. In general, the rocks at the surface have more gentle dips.

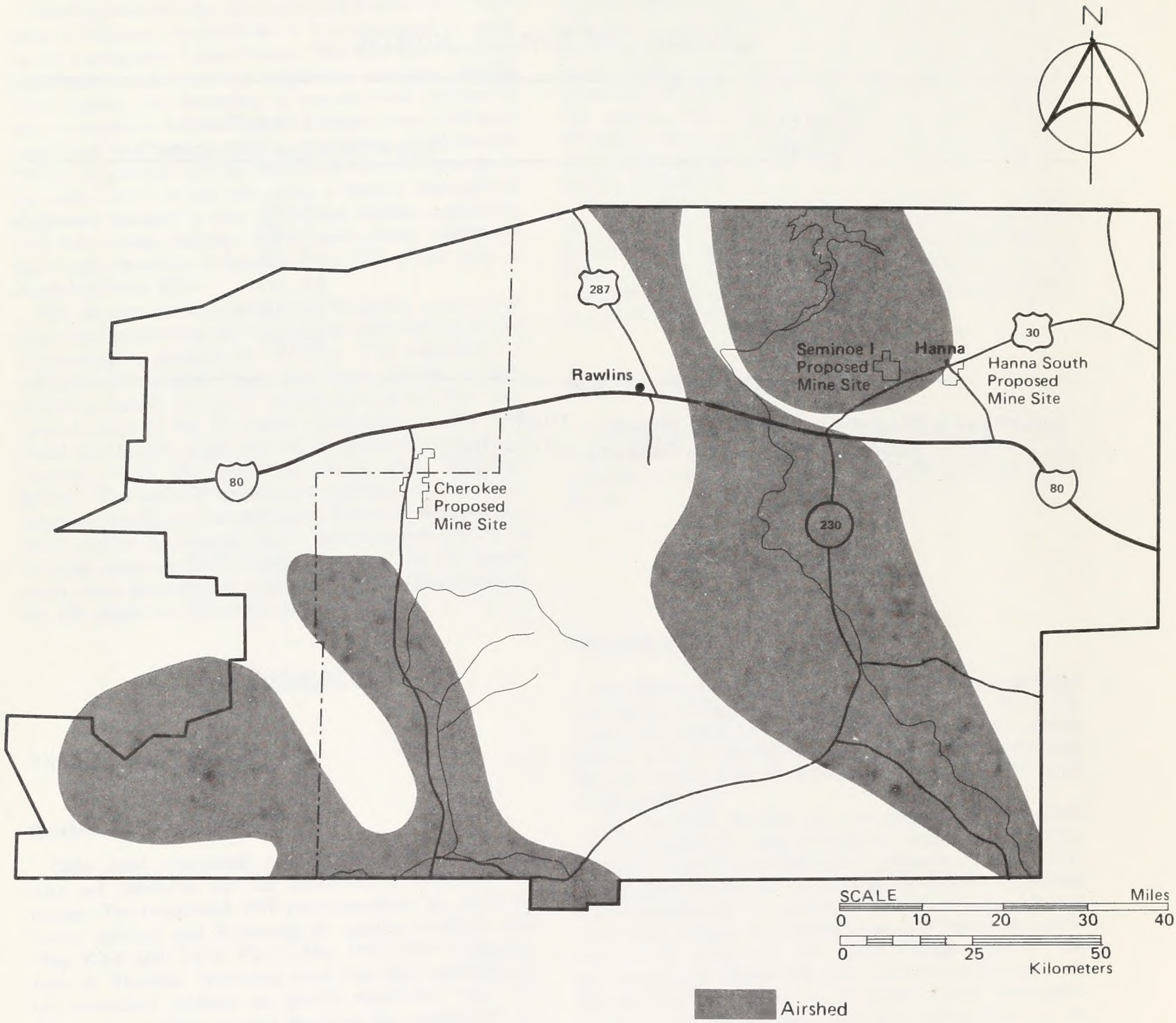
Table R2-6

ANNUAL STABILITY CLASS DISTRIBUTION

(PERCENT) FOR RAWLINS, WYOMING

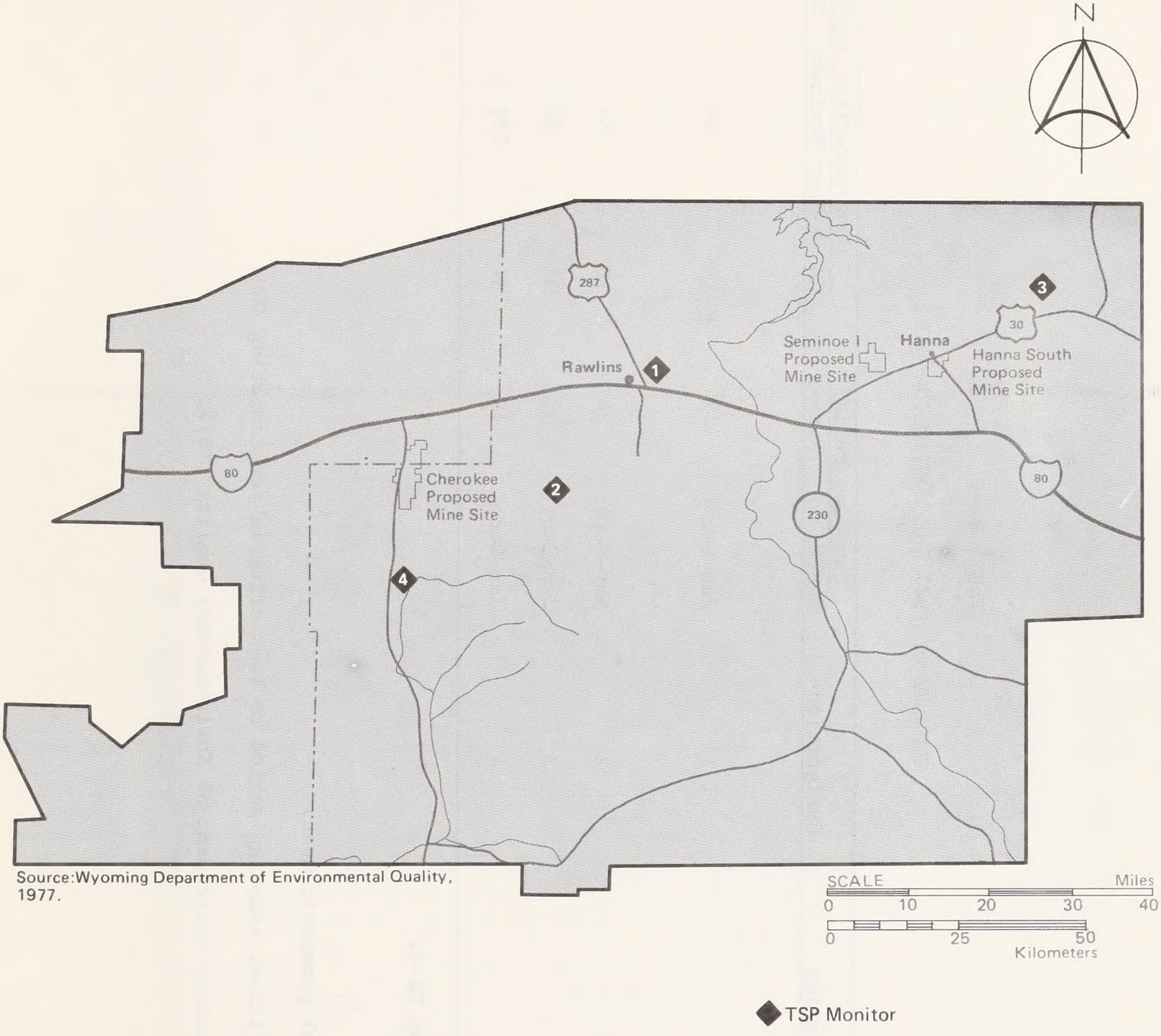
Stability Class	Stability Class Distribution (Percent)
A	2.02
B	4.30
C	7.35
D_1	28.86
D_2	29.18
E and F	28.29

Sources: National Climatic Center, 1968
National Climatic Center, 1955-1964.



Map R2-3

AIRSHEDS IN THE SOUTHCENTRAL WYOMING STUDY REGION



Source: Wyoming Department of Environmental Quality, 1977.

Map R2-4
LOCATIONS OF TSP MONITERING SITES

Table R2-7

SUMMARY OF 1977 TSP MONITORING DATA

Monitor Location	Site Designation*	Sampling Period		Concentrations ($\mu g/m^3$)		
		Months	Number	AGM	24-Hour Maximum	2nd Maximum
Urban Site						
Rawlins	1	Jan-Dec**	47	19	84	50
Rural Sites						
Espy Ranch	2	Mar-Sept	24	IS	54	53
Curry Ranch	3	Jan-Dec.	52	30	86	63
Adams Ranch	4	Jan-Dec.	48	31	136	106

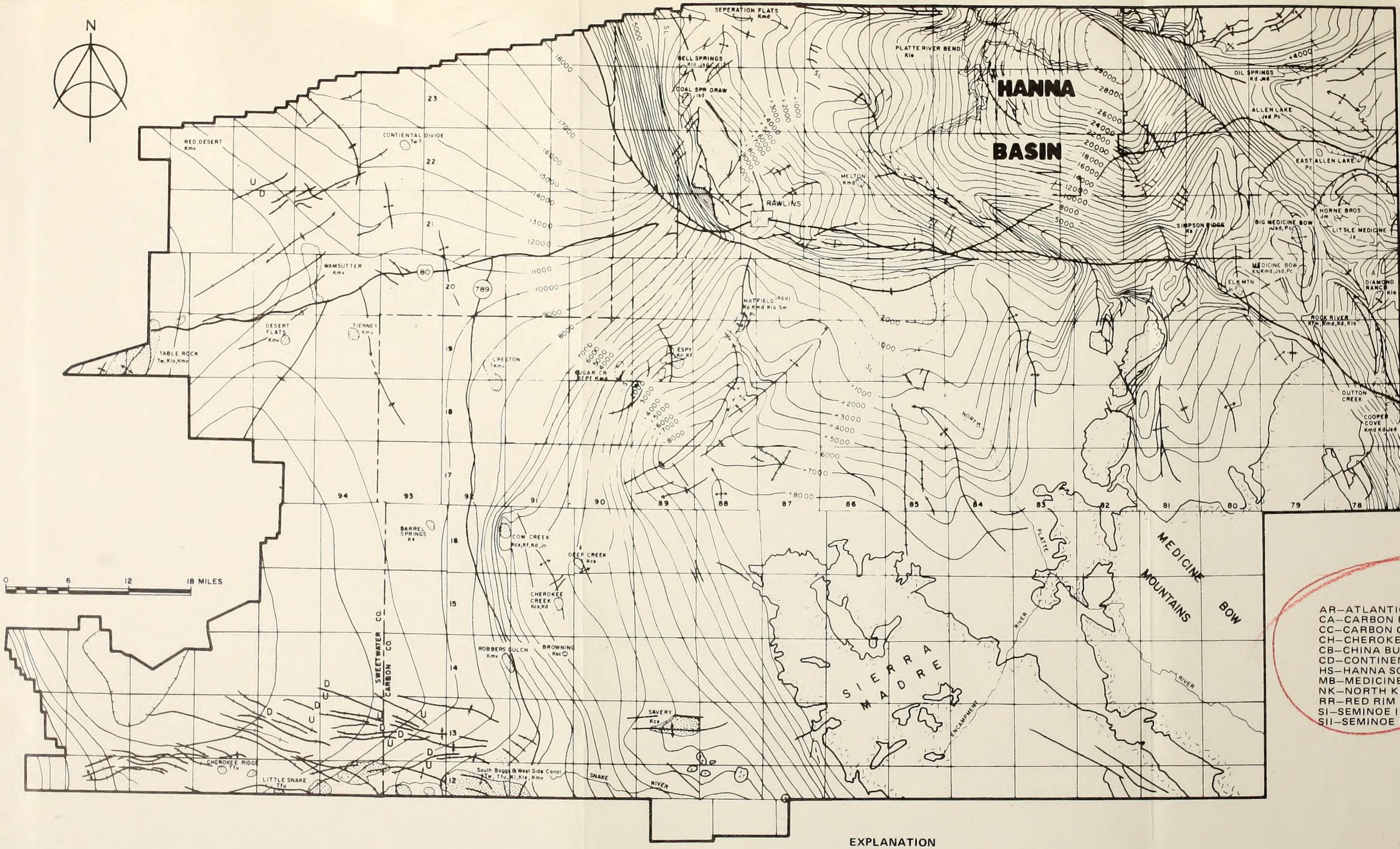
*Refer to Map R2-4.

**1976

AGM = Annual geometric mean.

IS = Insufficient sampling period to meet criteria for computing AGM.

Source: Wyoming Department of Environmental Quality, 1977.



AR—ATLANTIC RIM
CA—CARBON BASIN
CC—CARBON COUNTY
CH—CHEROKEE
CB—CHINA BUTTE—
CD—CONTINENTAL DIVIDE
HS—HANNA SOUTH
MB—MEDICINE BOW
NK—NORTH KNOBS
RR—RED RIM
SI—SEMINOE I
SII—SEMINOE II

EXPLANATION

OIL AND GAS FIELD

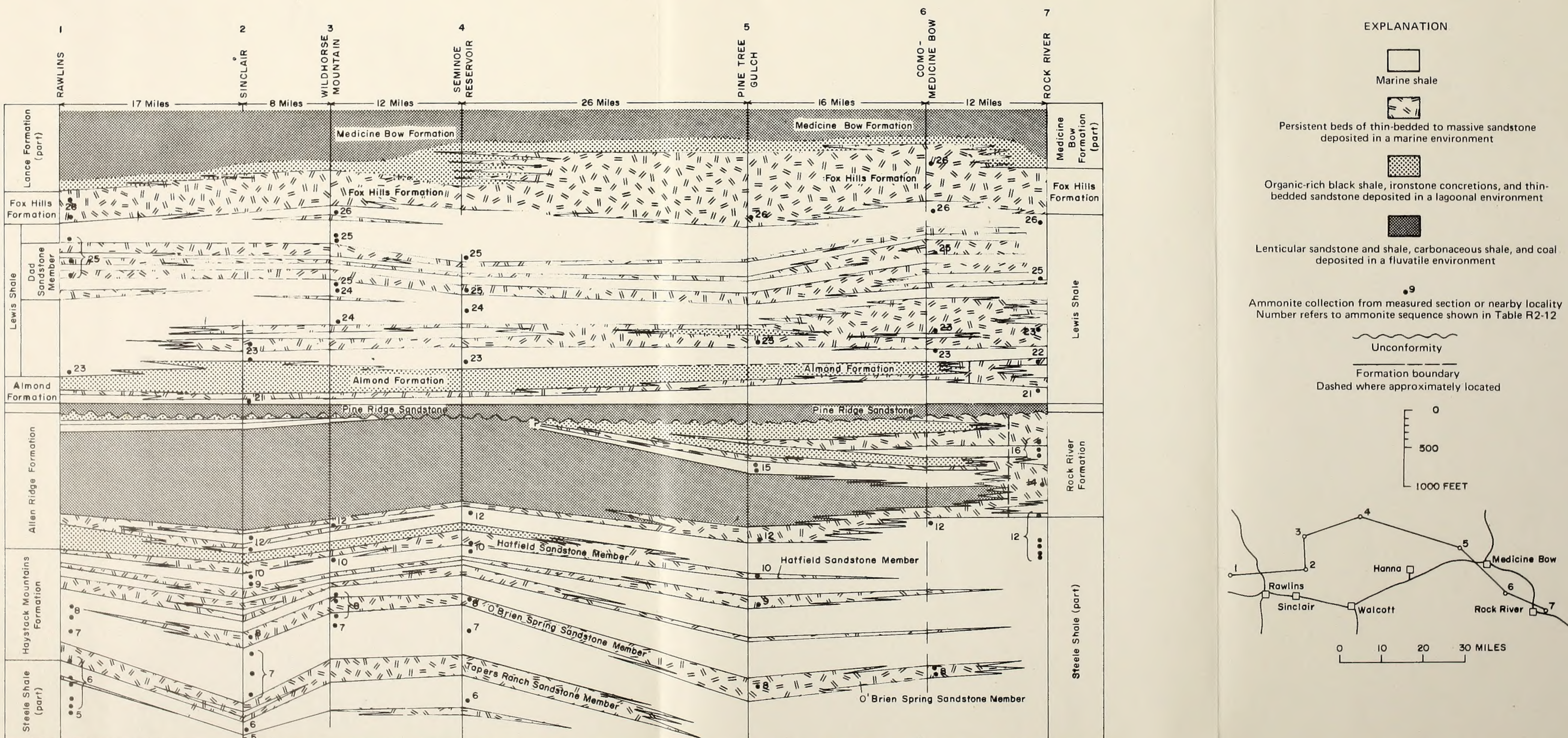
OUTLINE OF MINING PROJECT AREAS; LETTERS REFERRED TO IN TEXT

PRECAMBRIAN AREAS

CONVENTIONAL STRUCTURE SYMBOLS ARE USED; SHOWS MAJOR UPLIFTS, BASINS, ANTICLINES, SYNCLINES, AND FAULTS, AND THEIR RELATION TO THE MINING PROJECT AREAS. STRUCTURE CONTOURS AT 1,000-FOOT INTERVALS ON TOP OF CLOVERLY FORMATION. THIS IS A PORTION OF THE POMCO STRUCTURE MAP OF WYOMING, 1974 EDITION, BY BARLOW AND HAUN, INC., CASPER.

Map R2-5

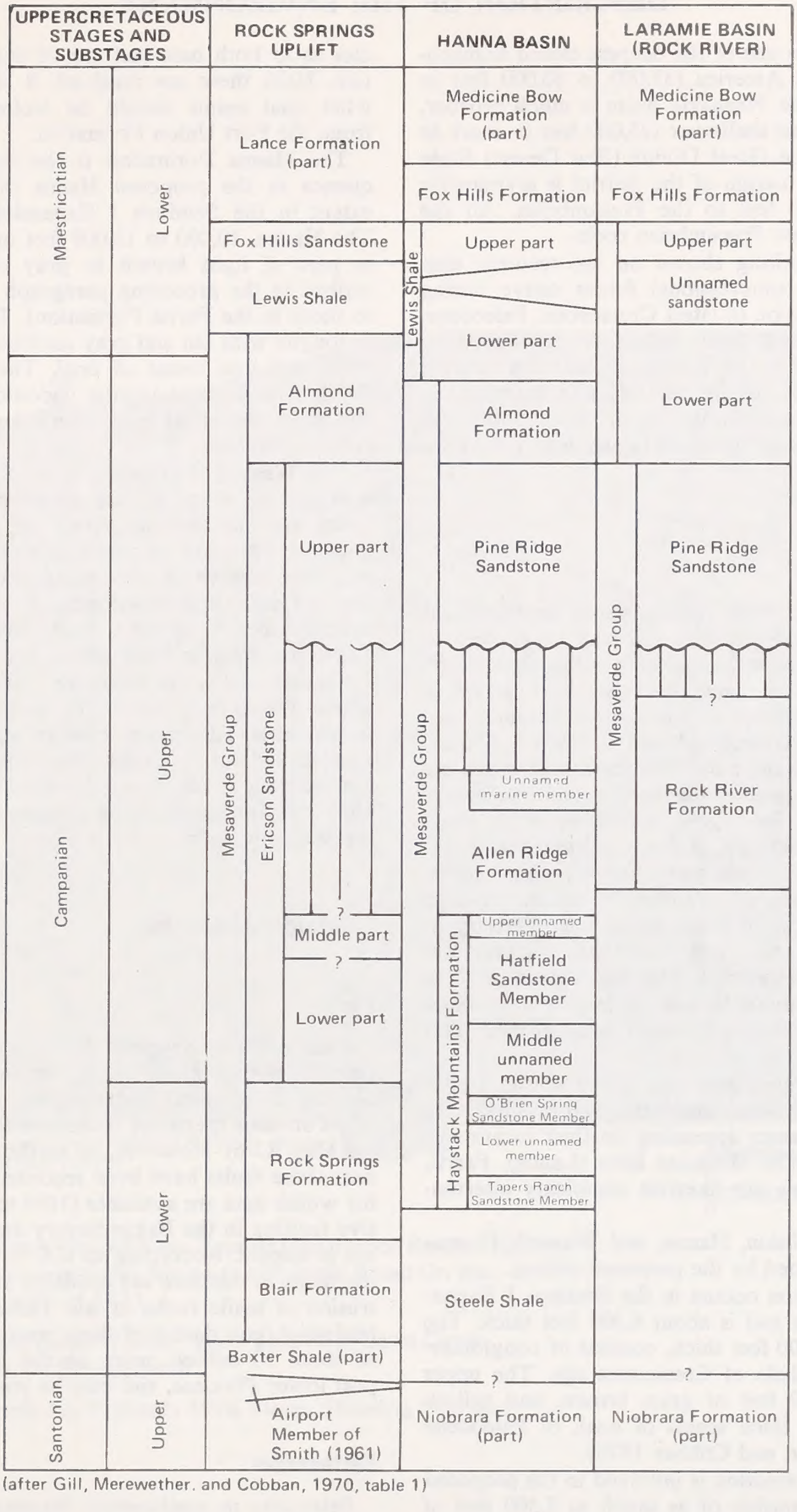
REGIONAL TECTONIC MAP OF SOUTHCENTRAL COAL REGION



(After Gill, Merewether, and Cobban, 1970, Figure 2)

Figure R2-2

STRATIGRAPHIC DIAGRAM SHOWING INTERTONGUING RELATIONS OF COAL-BEARING AND NON-COAL-BEARING ROCKS IN AND ADJACENT TO THE SOUTHCENTRAL COAL DISTRICT



(after Gill, Merewether. and Cobban, 1970, table 1)

Figure R2 - 3

CORRELATION OF UPPER CRETACEOUS ROCKS, THEIR RELATIVE AGES, AND CHANGES IN TERMINOLOGY FROM WEST TO EAST ACROSS THE SOUTHCENTRAL COAL DISTRICT

The Hanna Basin is one of the deepest closed sedimentary basins in North America (38,000 to 40,000 feet to the Precambrian). The Washakie Basin is much broader, more symmetrical, and shallower (25,000 feet or more to the Precambrian). The Great Divide (Red Desert) Basin along the northwest margin of the district is asymmetric and 25,000 to 30,000 feet to the Precambrian. All the mountain uplifts expose Precambrian rocks.

Most folding and faulting shown on the tectonic map was in response to compressional forces active during the Laramide Revolution in latest Cretaceous, Paleocene, and early Eocene times. Some subsidence continued on through Eocene time in the Washakie and Great Divide Basins. Late Cenozoic normal faulting and warping occurred on and along the margins of all the mountain uplifts and, in places, may have continued into the Holocene.

Stratigraphy

Formations are laid in discontinuous intertongued layers (Figure R2-2). Several names may be applied to formations of the same age, especially in the Upper Cretaceous Formations. A name correlation is given in Figure R2-3. For a complete stratigraphic column, see legend on Map 4 in Appendix A and the typed explanation that accompanies the map. The main rock types are granites, schists, and gneisses in the Precambrian mountain cores; quartzites, limestones, and slates in the overlapping Paleozoic rocks; and shales, sandstones, and siltstones of the Late Mesozoic and Early Cenozoic strata. Unusual concentrations of uranium, selenium, arsenic, and molybdenum occur in some of the Late Tertiary limestone, claystone, and shale beds (see Mineral Resources and Water Resources). The distribution of these rocks according to various formations largely determines the distribution of both soil types and groundwater aquifers.

The sandstones, shales, and coal seams in the Upper Cretaceous sequences are complexly intertongued and may have different names depending on their location in southern Wyoming. The Medicine Bow (Lance), Ferris, and Hanna Formations are likewise complexly intertongued.

The Ferris, Fort Union, Hanna, and Wasatch Formations would be disturbed by the proposed mining.

The Ferris Formation occurs in the Seminoe I Expansion mining plan area and is about 6,500 feet thick. The lower part, about 1,100 feet thick, consists of conglomerate, sandstone, and shale of Cretaceous age. The upper part consists of 5,400 feet of gray, brown, and yellow sandstone and many thick seams of coal, of Paleocene age (Gill, Merewether, and Cobban 1970).

The Fort Union Formation is involved in the proposed Cherokee Mine. It consists of as much as 2,500 feet of light gray thick coarse to fine-grained sandstones interbedded with conglomerate and carbonaceous shale, and at least one major coal seam 20 feet thick (Barlow 1953). In the area west and southwest of Rawlins, there are several interpretations in mining reports and published articles as to both base and top of the Fort Union Formation. Until these are resolved, it is difficult to describe what coal seams should be included in, or excluded from, the Fort Union Formation.

The Hanna Formation is the major coal-bearing sequence in the proposed Hanna South and to a lesser extent in the Seminoe I Expansion mining plan areas. The Hanna, 10,000 to 13,000 feet or more thick, consists in part of light brown to gray conglomerates as described in the preceding paragraph (that compares them to those in the Ferris Formation). The conglomerates intertongue with tan and gray sandstones, shales, and many thick and thin seams of coal. The Hanna overlies the Ferris with a major angular unconformity in some places and is so conformable in others that the contact is difficult to determine.

The Wasatch Formation is involved in the Cherokee mining plan area. It laps eastward onto the Rawlins Uplift and the east margin of the Washakie Basin, and thickens westward to about 3,000 feet in the basin. The base part consists of brown and gray arkosic conglomerate and sandstone intertonguing westward, as well as stratigraphically upward, with variegated to dark gray claystones, gray to black shales, and coal seams.

Several coal seams adjoining Cherokee as well as elsewhere throughout the entire northwestern part of the southcentral ES region contain significant amounts of uranium (Masursky 1962). The clinker derived from natural burning of this coal is likewise uraniferous. This uranium content needs to be considered in exploitation of the Wasatch coals.

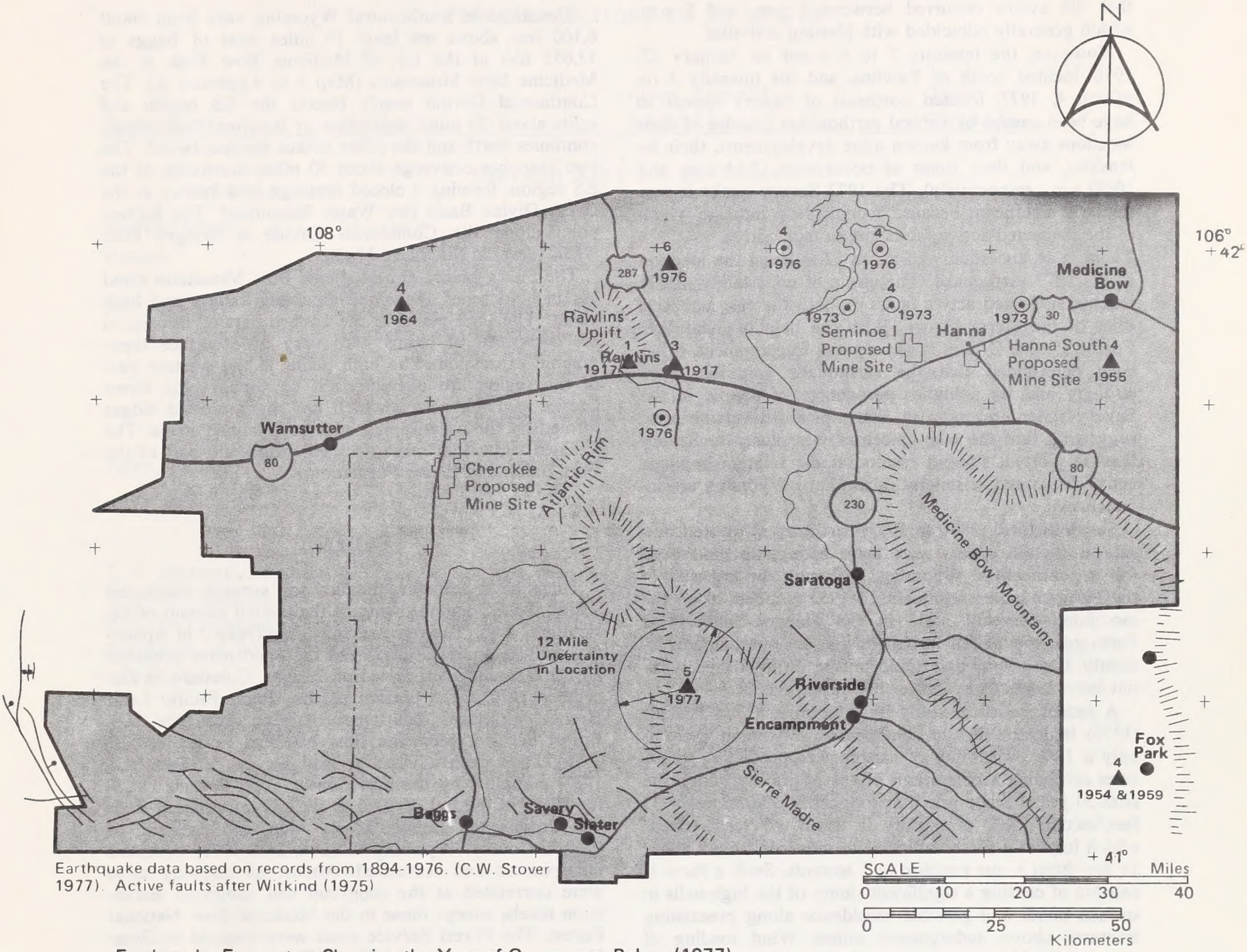
Geologic Hazards

Faults

Field evidence suggests the most active faults in southcentral Wyoming are along the northeast front of the Sierra Madre near Encampment, where normal faults offset streams (personal communication, J.D. Love 1977; see Map R2-6). However, no earthquakes with epicenters near these faults have been recorded during the 84 years for which data are available (1894 to present). The extensive faulting in the Baggs-Savery area may not be active, but is suspect. According to C.S.V. Barclay (1976, 1977), the faults in this area are probably associated with the intrusion of mafic rocks in late Tertiary time. Recent Potassium-Argon dating of these rocks gave minimum ages of about 10 million years, so the faults are presumably post lower Pliocene, and may be younger.

Earthquakes

Seismicity in southcentral Wyoming is not well determined by the sparse seismometer net, but the general level is considered low for Rocky Mountain areas (Simon 1972). There have been at least ten seismic events with modified Mercalli scale intensities of 3 to 6 in southcentral Wyoming in the last 10 years, some of



Earthquake data based on records from 1894-1976. (C.W. Stover 1977). Active faults after Witkind (1975)

▲ Earthquake Epecenters Showing the Year of Occurrence Below (1977) and the Maximum Intensity (5) Above the Traingle Based On the Modified Mercalli Scale of 1931.

Known or Suspected Active Faults. Short Line With Solid Circle Indicates Downthrown Side of Fault

⊙ Seismic Events Which Are Probably Mine Blasts, Showing Year and Intensity

Map R2-6

SEISMICITY AND KNOWN OR SUSPECTED ACTIVE FAULTS IN SOUTHCENTRAL WYOMING

which have probably been caused by mine blasts in the Hanna Basin as indicated by information which shows that the events occurred between 1 p.m. and 5 p.m. which generally coincided with blasting activities.

However, the intensity 5 to 6 event on January 27, 1976, located north of Rawlins, and the intensity 5 on March 4, 1977, located northeast of Savery appear to have been caused by natural earthquakes because of their locations away from known mine developments, their intensities, and their times of occurrence (3:54 a.m. and 10:50 a.m., respectively). The 1977 Savery quake is particularly significant because it could help indicate which of the suspected active faults are, in fact, active.

There is an uncertainty of about 12 miles in the location of the 1977 earthquake. The circle of uncertainty nearly reaches suspected active faults on both the east and west sides of the Sierra Madre. With the help of local U.S. Forest Service Offices in Savery and Encampment, it has been determined that the earthquake was felt more strongly and by a higher percentage of people in the Savery-Slater area than in Encampment-Riverside area, suggesting that the true epicenter was closer to Savery than as plotted. Present results on the relation between active faults and seismicity in southern Wyoming are inconclusive.

Seven historic (1894 to 1973) earthquakes located outside of the ES region were large enough to have been felt in southcentral Wyoming. Although the intensity of the Hebgen Lake earthquake of 1959 reached 10 on the modifided Mercalli scale in the Hebgen-Yellowstone Park area, it was felt in Rawlins at the approximate intensity 3 to 4 level and could not be distinguished without instruments from smaller but closer events.

A recent statistical study by Algermissen and Perkins (1976) indicates that in southcentral Wyoming there is only a 10% probability of earthquakes producing vibrations exceeding accelerations of 4% of gravity within the next 50 years. Since gravity produces accelerations of 32 feet/second^2, 4% of gravity is about 1.3 feet/second^2 which implies a force sufficient to move an object about 16 feet from a rest position in 5 seconds. Such a force is capable of causing a significant slump of the highwalls in surface mines and possible subsidence along preexisting fractures above underground mines. Wind loading of structures, which can cause accelerations in excess of 4% of gravity value, is expected to be the governing factor in the design of structures and not earthquake shaking.

Paleontology

To date, only a limited number of paleontological surveys have been conducted in the region, with the majority of attention being given to fossil vertebrates. A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in proposed action areas of the ES region is presented in Table R2-8.

TOPOGRAPHY

Elevations in southcentral Wyoming vary from about 6,100 feet above sea level 10 miles west of Baggs to 12,055 feet at the top of Medicine Bow Peak in the Medicine Bow Mountains (Map 1 in Appendix A). The Continental Divide nearly bisects the ES region and splits about 20 miles southwest of Rawlins. One branch continues north and the other strikes northeastward. The two branches converge about 50 miles northwest of the ES region, forming a closed drainage area known as the Great Divide Basin (see Water Resources). The highest point along the Continental Divide is Bridger Peak (11,007 feet) in the Sierra Madre.

The Sierra Madre and Medicine Bow Mountains stand out in bold relief above the mountain valleys and high plains. The high plains in the eastern part of the region are composed of basins with very little surface topographic expression. The high plains in the western part of the region are characterized by topographic forms known as "hogbacks", which are sharp crested ridges formed by the outcropping edges of inclined strata. The inclined strata that make up these ridges are part of the Fort Union and Lance Formations.

SOILS

There have been few detailed soil surveys conducted within the ES region owing to the limited amount of agricultural land. The regional soils map (Map 5 in Appendix A) was compiled from soil data and maps prepared by Intrasearch Incorporated of Denver, Colorado, in December 1976, for a portion of the Union Pacific Land Grant. Additional data were obtained from the U.S. Forest Service (Medicine Bow National Forest) (Hoeft 1976). Data from a Class IV soil survey (USDA, SCS 1977) compiled by the Soil Conservation Service (SCS) for BLM in the fall of 1976 as well as information from the Provisional General Soils Map and Legend of Carbon County, Wyoming (USDA, SCS 1978) were also incorporated and correlated. Almost all mapping areas were correlated at the subgroup and subgroup association levels, except those in the Medicine Bow National Forest. The Forest Service areas were mapped as Great Group association levels. This difference in classification levels can be seen at the boundaries of the Medicine Bow National Forest.

Since very little ground correlation and truthing (field checking) was possible, mapping units are very general and each unit has a broad range and number of additional soil types. The nature of soil association mapping units is basically a grouping of soils similar to each other according to pattern and position, and not on a basis of capability at expected response. These mapping associations are named according to the dominant soils occurring within the delineation. This allows minor soils that would be significant to management to be omitted. This, along with the unknown percent of component units of a mapping unit, makes detailed soil mapping unit interpretations impossible.

Table R2-8

SUMMARY OF FOSSIL LOCALITIES IN AREAS OF PROPOSED ACTIONS IN ES REGION

Formation	Period	Known Fossil Localities	Type of Fossils
		Eastern Part of ES Region	
North Park	Miocene	General	V*
Hanna	Upper Paleocene/ Lower Eocene	General	I, V, P
Ferris	Lower Paleocene/ Upper Cretaceous	General	I, V, P
		Western Part of ES Region	
Fort Union	Paleocene	General	V, P

I = Invertebrate
V = Vertebrate
P = Paleobotanical
General = Formation contains fossils throughout; specific localities are not available.

*Extremely rare

In Table R2-9, a general description of mapping unit properties and uses is summarized.

Regional Soil Types

Some of the most extensive soils in the ES region are the Typic Natrargids (mapping unit 16); Typic Torrifluvent (17, 41); Typic Torriorthents (13, 24, 27, 29, 37, 45); Typic Calciorthids (14, 45); and Typic Haplargids (21). These soils receive the lowest precipitation (5 to 9 inches) and occur in the western portions of the ES region where landforms are basins, alluvial drainages, flood plains, mesas, residual uplands, terraces, buttes, and mountain toeslopes. Elevations range from 5,900 to 6,900 feet.

These soils are dominated by a complex of big sagebrush, grasses, saltbush, and greasewood vegetative types. Typic Natrargids (16) and Typic Torrifluvents (17, 41) are deep, well and moderately well drained silty clay loam to fine sandy loam soils associated with the saltbush, greasewood, and birdsfoot sagewort vegetative types. The Natrargids have high levels of sodium salts in the surface and subsoil horizons which would severely limit their utilization and management.

The parent material of these soils consists primarily of weathered sedimentary rocks (sandstones, shales, limestones, siltstones, and mudstones). These rocks are commonly interbedded and the alluvial fan and valley soils are a complex of these sediments from coarse-grained sandstones to clayey shales. Calcareous limestones and sandstones are the source of carbonates found especially in the Typic Calciorthids (14, 45). In these sedimentary rocks (Mesaverde Formation), there are scattered and diffuse concentrations of toxic material, such as selenium, boron, arsenic, and uranium.

The Typic Haplargids (21) are moderately deep and deep well drained sandy clay loams to sandy loam soils. These well developed soils, on nearly level to sloping residual uplands, are fair to good sources of topsoil material.

The Typic Torriorthents (13, 24, 27, 29, 37) are very shallow to deep, well drained, clay loams to sandy loam soils that are among the youngest and least developed in the region. They have no discernable diagnostic horizons since they are dominated by mineral soil material associated with recent alluvium and actively eroding slopes.

Ustic Torriorthents (mapping units 7, 8, 34, 35, 44, 45, 52, 70); Borollic Haplargids (3, 5, 11, 33, 57, 59, 62); Borollic Natrargids (60), and Borollic Calciorthids (54) are those cool (frigid) soils that predominately occur on residual uplands, mountain toeslopes, and upland alluvial fans. These soils receive generally 10 to 14 inches of precipitation and range in elevation from 6,500 to 7,800 feet. The soils in mapping units 3, 7, 44, 52, 54, and 60 are the principal regional soil types occurring over the Cherokee site specific and Hanna Basin sites.

These soils are dominated primarily by mountain shrub and sagebrush. The mountain shrub vegetative type is in a complex with sagebrush, scrub aspen, true mahogany, serviceberry, juniper, forbs, and grasses. The Borollic Natrargids (60) are moderately deep and deep well drained sandy clay loams and clay loams associated with the birdsfoot sagewort and Gardners saltbush vegetative types. The high levels of sodium salts in subsoil would severely limit their utilization and management.

The parent material of these soils is primarily interbedded sedimentary rocks. However, in soils near the Medicine Bow National Forest, the parent material also includes alluvium of metamorphic and igneous rocks originating from the mountains. In the Borollic Calciorthids (54), sources of carbonates are the calcareous limestones and sandstones interbedded in the sedimentary rocks.

The Ustic Torriorthents (7, 8, 34, 35, 44, 52, 70) are very shallow to deep excessively well to well drained sandy loam to clay loam soils whose profile development has no discernable diagnostic horizons. These soils range from poor to fair in their utilization for reclamation. The Borollic Haplargids (5, 11, 33, 57, 59, 62) are well developed moderately deep to deep well drained clay loam to sandy loam soils. They occur primarily on nearly level to sloping residual uplands and alluvial fans. Some of these soils are used for irrigated cropland.

The Fluvents (51, 73); Aquents (51, 73); and Aquolls (73) occur mainly in the river valleys of the region. Included are the Little Snake River, North Platte River, Encampment River, and Medicine Bow River. These areas are characterized by level river bottom flood plains and adjacent irrigated lands. These are somewhat poorly to poorly drained silty clay loams, clay loams, sandy clay loams, and silty clays. The native vegetation is mainly willows, cottonwoods, and water and salt tolerant grasses and sedges. Some areas of these soils are highly saline and alkaline. These soils are used for irrigated hayland, irrigated cropland, and irrigated pastures. These soils with adjacent irrigated benches (Borollic Haplargids) make up the alluvial valley floors and prime farmland in the ES region.

The cold (cryic and pergelic) soils Cryoborolls (30, 31, 61, 62); Cryoboralfs (66, 81, 85, 87, 95); Cryochrepts (65, 81, 82, 91A, 95); and Pergelic Cryochrepts and Pergelic Cryothents (82, 90) of the ES region occur on the gently sloping foothills to very steep valleys, canyons, flat ridgetops, and rough broken mountain crests of the Sierra Madre and Medicine Bow ranges. Elevation ranges from 7,900 to 12,000 feet. Precipitation ranges from 15 inches in the foothills to 40 or more inches on the mountain crests. The vegetation ranges from sagebrush, mountain shrub, and aspen on the foothills, to lodgepole pine in the intermediate and spruce-fir in the intermediate and mountain crest zones.

The parent material varies greatly. In the foothills, it is generally sedimentary and alluvial. In the mountain areas, it is sedimentary, precambrian igneous and metamorphic, and precambrian granite. The mountain crests are generally glacial deposit areas.

The soils are fine to coarse textured and range in depth from very shallow to very deep. They usually are well drained, except in drainageways and meadows (glacial) which often have a seasonal high watertable. The mean annual soil temperature of the pergelic soils is less than 32°F.

Table R2-9

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential* Index	Comments
1	Seaverson-Rallod-Blazon Association	Ustic Torriorthents	Residuum from alkaline shales	12-20	10-30	Poor	High subsurface alkaline slope, shallow depth, severe erosion hazard
2	Monte-Luhon-Garita Association	Typic Torriorthents	Medium-textured alluvium from rhyolite & lateritic rocks	60	0-6	Good	Flood plain locations, flooding hazards
3	Cushool-Ryan Park-Satanka Association	Borollic Haplargids	Soft sandstones & sandy shales	34-60	2-30	Fair-Good	Slope hazards & shallow surface horizons
4	Cushool-Worfman-Blanyon Association	Borollic Vertic Haplargids	Residuum from sandstone & siltstone	30-36	6-30	Poor	Steep slopes
5	Rock River-Diamondville Tasselman-Ryark Association	Borollic Haplargids	Calcareous, moderately coarse textured alluvium from sandstone, & sandy shales	60	2-30	Fair-Good	Slope hazard
6	Forelle-Monte-Havre Association	Borollic Haplargids & Typic Torriorthents	Alluvium from sedimentary rock	44-50	0-40	Fair	Slope hazard
7	Patent-Seaverson Association	Ustic Torriorthents	Residuum from alkaline sandy shales	18-50	3-20	Poor	Alkalinity and shallow depth
8	Blazon-Worfman-Shinbara-Haterton Association	Ustic Torriorthents	Weathered soft shale interbedded with sand-stone & loamstone	10-20	3-40	Poor	Slope hazard and shallow
9	Rockland Land Type	----	Sandstone barren shales	0	Varies	None	

Table R2-9 (Continued)

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential* Index	Comments
11	Rock River-Satanka Association	Borollic Haplargids	Calcareous, moderately coarse textured alluvium from sandstone, & sandy shales	60	3-20	Good	Slop hazard
12	Dune Sands Land Type	----	Dune sands	Varies	Varies	Poor	Need irrigation, organic matter, fertilizer
13	Typic Torriorthents	Subgroup	Fresh water shales and sandstones	20+	6-40	Fair	Low organic matter, high erosion hazard
14	Typic Calciorthid	Subgroup	Salty marine shales	20+	3-20	Poor	Need intensive & coordinated agronomic practices
15	Alkali-Saline Soils Land Type	Land Type	Salty alluvium from uplands	Varies	0-10	Poor	Salinity & alkalinity
16	Typic Natrargids	Subgroup	Salty alluvium from uplands	Varies	0-10	Poor	Climatic stress, alkaline
17	Typic Torrifluvent	Subgroup	Alluvium	Varies	0-6	Fair	Floodplain, surface disturbance when wet
18	Forelle-Diamondville Association	Borollic Haplargids	Alluvium from sedimentary rocks	40-50	0-30	Fair	Slope hazard
19	Alcova-Bosler Association	Borollic Haplargids	Gravelly alluvium	60	1-15	Fair	Thin layer, small stones, clayey
20	Typic Camborthids	Subgroup	Fresh water shales and sandstones	20+	3-40	Fair	Low organic matter, water slopes
21	Typic Haplargids	Subgroup	Fresh water shales and sandstones	20+	3-10	Fair	Low organic matter and available moisture

Table R2-9 (Continued)

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential* Index	Comments
22	Xeropsamments	Great Group	Well-sorted sands	20+	Varies	Poor	Low water hold capacity high erosion potential
23	Starman-Barrett Association	Lithic Cryorthents	Residuum from sandstone &	8-10	6-40	Poor	Slope hazard, shallow depth
24	Horsley-Shale Outcrop Association	Typic Torriorthent & Shale Rock Land Type	Residuum from sandy shales	8	10-40	Poor	Slope hazard, shallow depth
25	Mayorworth Series	Argic Cryoborolls	Residuum from sandy shales	20-40	6-20	Poor	Slope hazard, high erosion
26	Boltus-Shale Outcrop Association	Typic Torriorthent & Rockland Land Type	Residuum from gypsin ferous shales	10	3-15	Poor	Slope, depth to bedrock
27	Hugston-Terada Association	Typic Torriorthent	Residuum from sandstone	10-20	6-40	Poor	Slope depth to bedrock
29	Monte-Saline Debone Complex	Typic Torriorthent	Medium-textured alluvium	60	0-6	Poor	Salinity or alkalinity
30	Echemoore-Inchau Complex	Argic Pachic Cryoborolls	Alluvium	20-40	6-15	Fair	Slope, moderate erosion hazard
31	Contide-Millerlake-Asperson Complex	Typic Cryoborolls	Colluvium from shales	60	6-40	Poor	Severe slope, severe erosion hazard
32	Hub-Rimton Association	Mollic Cryoboralfs	Local alluvium or slope wash materials	60	6-40	Poor	Severe slope hazard
33	Chaperton-Boettcher Association	Borollic Camborthids	Residuum from limestone & shale	20-40	3-20	Poor	Alkalinity and slope

Table R2-9 (Continued)

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential* Index	Reclamation Potential* Comment
34	Patent-Blazon-Delphill Association	Ustic Torriorthent	Loamy alluvium	60	6-40	Fair	Alkalinity and steep slopes
35	Cragosen-Lupinto Association	Ustic Torriorthent	Thin gravelly alluvium	10-20	10-40	Poor	Shallow depths and steep slopes
36	Middlewood-Morling Association	Borollic Lithic Haplargids	Residuum from noncal-careous shales	10-20	6-30	Poor	Shallow depths and steep slopes
37	Garsid-Haterton-Monte Association	Typic Torriorthent	Residuum from siltstone	20-40	3-30	Poor	Shallow surface horizon and slopes
38	Sagecreek-Unson Association	Typic Camborthid	Alluvium	60	0-3	Good	Low organic matter, need water
39	Havre Glendive Association	Ustic Torrifluvents	Calcareous stratified loamy alluvium	40	0-6	Fair	Alkalinity, floodplain & stream terrace locations
41	Ustic Torrifluvents	Subgroup	Alluvium	40+	0-6	Fair	Floodplain location, lack of agronomic materials
43	Typic Torripsamments (40%) Dune Sand (60%) Association	Subgroup & Land Type	Eulian sands	Varies	3-20	Poor	Sandy material, low water capacity, high wind erosion
44	Ustic Torriorthent (60%) Lithic Torriorthent (20%) Rock Outcrop (20%) Association	Subgroup	Varies	Varies	3-40	Poor	Shallow depth, high erosion, lack of agronomic materials
45	Typic Calciorthid (60%) Ustic Torriorthent (40%) Association	Subgroup	Varies	20+	3-20	Fair	Lack of agronomic material; erosion hazard on steeper slopes

Table R2-9 (Continued)

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential* Index	Comment
51	Fluvents-Aquents Association	Suborder	Alluvium	20+	0-6	Fair-Good	Floodplain location
52	Ustic Torriorthent (65%) Rock Outcrops (35%) Association	Subgroup & Land Type	Variable Residuum	10-20	6-40	Poor	Slope, shallow depth
53	Mining Areas	Disturbed land	Varies	Varies	20-40	Poor	High erosion, lack of agronomic material
54	Typic Calciorthid (30%) Ustic Torriorthent (60%) Rock Outcrops (10%) Association	Subgroup & Land Type	Varies	Varies	3-40	Poor	High erosion, lack of agronomic material
55	Borollic Haplargids (50%) Ustic Torriorthent (50%) Association	Subgroup	Varies	20+	3-40	Fair	Erosion hazard on steeper slopes
56	Lithic Cryoboralfs (20%) Mollic Cryoboralfs (50%) Lithic Cryorthents (20%) Rock Outcrops (10%) Association	Subgroup	Varies	Varies	10-40	Poor	Depth to rock, erosion hazard
57	Borollic Haplargids (80%) Ustic Torriorthent (20%) Association	Subgroup	Varies	20+	3-40	Fair	Erosion hazard
59	Borollic Haplargids	Subgroup	Varies	20+	3-6	Good	Low water availability
60	Borollic Natrargids	Subgroup	Salty Alluvium	20+	3-6	Poor	Alkalinity

Table R2-9 (Continued)

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential*	
						Index	Comments
61	Agric Cryoborolls (40%) Typic Cryoboralfs (60%) Association	Subgroup	Varies	20+	3-20	Fair	Slope hazard
62	Agric Cryoborolls (50%) Borollic Haplargids (50%) Association	Subgroup	Varies	20+	3-6	Good	Need water
65	Typic Cryochrepts (70%) Typic Cryoboralfs (30%) Association	Subgroup	Varies	20+	10-40	Poor	Erosion hazard, slopes
66	Typic Cryoboralfs	Subgroup	Varies	20+	10-40	Poor	Erosion hazard, slopes
70	Ustic Torriorthent (60%) Rock Outcrops (20%) Lithic Ustic Torriorthent (20%) Association	Subgroup	Varies	Varies	10-40	Poor	Erosion hazard, slope, lack of agronomic materials
73	Fluvents, Aquents, Aquolls Association	Suborder	Alluvium	20+	3-6	Fair-Good	Floodplain location
80	Cryoborolls, Cryaquolls Cryoboralfs	Great Group	Alluvial and colluvial	40+	5-20	Fair	Cold temperature regime, high water table
81	Cryboralfs, Cryochrepts, Cryaquolls	Great Group	Alluvial and colluvial material from fine grained igneous & metamorphic rock	Varies	10-40	Poor	Erosion hazard, slope, depth to bedrock
82	Pergelic Cryochrepts Pergelic Cryorthents	Subgroup	Glacial deposits	36+	10-30	Poor	Slope, high water table, cold temperature regime
83	Cryochrepts, Cryoboralfs Cryaquepts, Cryaquolls	Great Group	Glacial deposits and alluvium	36+	0-20	Poor	High water table, cold temperature regime

Table R2-9 (Continued)

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential* Index	Comment
84	Cryochrepts, Cryoboralfs Cryaquepts, Cryaquolls	Great Group	Glacial deposits and alluvium	20+	0-20	Poor	High water table, cold temperature regime
85	Cryoboralfs, Cryochrepts Cryoborolls	Great Group	Alluvium from sedimentary rocks	20+	10-35	Poor	Slope, erosion hazard
86	Eutroboralfs, Argiborolls Haploborolls	Great Group	Sandstone conglomerate	36+	0-20	Fair	Slope, coarse fragments
87	Cryoboralfs, Cryochrepts	Great Group	Sedimentary rock	36+	15-35	Poor	Slope, coarse fragments
88	Cryoboralfs, Cryaquolls Cryaquepts	Great Group	Alluvial and colluvial deposits	40+	0-20	Poor	High water table, coarse fragments
89	Cryoboralfs, Cryoborolls Cryaquolls	Great Group	Sedimentary rock	30+	0-20	Poor	High water table, cold temperature regime
90	Pergelic Cryochrepts Pergelic Cryorthents	Subgroup	Glacial	Varies	10-30	Poor	Cold soil temperatures
91A	Cryoboralfs, Cryochrepts Cryoborolls, Cryaquolls	Great Group	Glacial and alluvial	10+	30-70	Poor	Slopes
91B	Cryoboralfs, Cryochrepts Cryoborolls, Cryaquolls	Great Group	Glacial and alluvial	Varies	20-40	Poor	Slopes
92A	Cryoboralfs, Cryochrepts Cryoborolls, Cryaquolls	Great Group	Alluvial	Varies	10-35	Poor	Slopes, coarse fragments
92B	Cryoboralfs, Cryochrepts Cryoborolls, Cryaquolls	Great Group	Alluvial	Varies	10-35	Poor	Slopes, gravelly subsoils shallow depths
92C	Cryoboralfs, Cryochrepts Cryoborolls, Cryaquolls	Great Group	Alluvial, residuum	Varies	10-40	Poor	Slopes, shallow depths

Table R2-9 (Continued)

ES REGION SOIL PROPERTIES AND USE

Map Reference #	Mapping Units	Taxonomic Classification	Parent Material	Depth (in inches)	Slope(%)	Reclamation Potential* Index	Comments
93	Eutroboralfs, Haploboralfs	Great Group	Sandstone	20+	0-20	Fair	Slopes
94	Cryochrepts, Cryoboralfs	Great Group	Basalt	10+	30-50	Poor	Slopes, shallow depths
95	Cryochrepts, Cryoboralfs	Great Group	Sedimentary	10-40	30-60	Poor	Slopes, shallow depths
96	Cryoboralfs, Cryoborolls	Great Group	Sandstone	20+	0-20	Fair	Slope, cold temperature regime
L	Lake Bed Land Type	----	Alluvium	40+	0-2	Poor	Salinity, alkalinity, high water table
LS	Land Slide Land Type	----	Varies	Varies	20-60	Poor	Slope, unstable

*Reclamation Potential--Index:
Poor--steep slopes, high concentration of salts, high erosion, shallow soils or combination;
Fair--between poor and good, has problems in reclamation but not severe;
Good--slopes are level to gentle, good levels of organic matter, water availability is good.

Source: (Hoeft 1976)
(Intrasearch 1976a)
(Intrasearch 1976c)
(USDA Soil Conservation Service 1977)
(USDA Soil Conservation Service, March 1978)
(USDA Soil Survey Staff, Soil Taxonomy 1975)

WATER RESOURCES

Water resources of the ES region are limited and are controlled by the Wyoming Constitution and Statutes, interstate compacts, and international treaties. The Wyoming Constitution and Statutes are based on the premise that the highest preferred use is "water for drinking purposes for both man and beast". To implement this premise and to protect prior rights, each diversion, impoundment, interception, or use of water requires a permit from the State Engineer.

The amount of water that can be used in the region is restricted by the North Platte River Decree of 1945 as amended in 1952, the Colorado River Compact of 1922, the Upper Colorado River Compact of 1948, and Mexican treaties (Rechard and Ragsdale 1971). The North Platte River Decree limits the amount of any further irrigation development, but does not apply to normal municipal supply. The Colorado River compacts specify the amounts of water that can be used from the Green River Basin, but not the amount from the Little Snake River, which depends on priority rights and surplus runoff. Wyoming's share of the surplus in the Little Snake River basin is approximately 200,000 acre feet per year (ac ft/yr).

Numerous sites in the region have been withdrawn as public water reserves. None of these are in areas that would be disturbed by the proposed actions, but many lie within areas of interest for possible future mining. No operation for recovery of leasable minerals can interfere with the purpose for which the site was withdrawn unless the withdrawal is set aside. The purpose for each reserve has not been researched at this time, but will be if additional mine plans are considered.

Because of a lack of detailed data, only broad estimates can be made of water supply and uses in the region, which includes parts of the Green River, North Platte River, and Great Divide basins (Map 6A Appendix A). Previous water studies have been for small local areas or for the major river basins.

Resources in various parts of the region have been described by Davis (1976 a to e), Bureau of Land Management (1975a), Welder and McCreevy (1966), Lowery et al. (1973), Berry (1960), Visher (1962), Wyoming State Engineer (1970, 1971, 1973, 1974), Wyoming Department of Environmental Quality (1976 a to b), and Lowham et al. (1976).

Water Use

The most important question related to mining and water resources in the southcentral region is whether the mines would alter or reduce already short supplies. Special attention focuses on the supply for municipal use, although the principal use of water in the southcentral region is for irrigation (see Table R2-10).

The Wyoming State Engineer (1971) shows a yearly use of 95,700 ac ft/yr for irrigation in Saratoga Valley; and 49,600 ac ft/yr in the Medicine Bow River Basin. The Wyoming Water Planning Program (personal communication 1977) indicates that 11,400 ac ft/yr is used in the Little Snake River Basin. The total use in the ES region is 167,000 ac ft/yr; essentially all of which is surface water. Surface water from the region is also used for irrigation outside the region along the North Platte River, Rock Creek, and Little Snake River. In addition to the actual amount used, there is another 41,700 acre feet lost by evaporation from reservoir surfaces.

The second largest use is for municipal supply. Although fairly substantial quantities of water exist in the region, there are few good supplies near the population centers. The only dependable surface supply near the principal towns of Rawlins, Saratoga, and Hanna is the North Platte River which is unsatisfactory for year-round use because of high turbidity and previous allocations for other uses. Aquifers that could produce enough water for city use generally lie deep below the land surface and most of these have very poor quality water.

The Rawlins supply comes from 24 springs, where the city has rights to 4.2 million gallons per day (mgd), in the Sage Creek Basin 29 miles south of the city. The discharge at the springs varies from 1.9 mgd to 5.8 mgd (HNTB 1977b). The system can convey a maximum of 2.9 mgd to storage reservoirs, which supply a peak demand of 4.1 mgd. The yearly discharge from the springs has not been measured, but is estimated to be 1.5 to 2 times the yearly use which averages 2.0 mgd. The supply from the springs is augmented by rights to 3.4 mgd from surface runoff near the springs and by 1.5 mgd from the North Platte River. The distribution system is inadequate to meet peak demands.

Hanna draws its water from springs near Rattlesnake Creek on Elk Mountain. Medicine Bow and the town of Elk Mountain use water from artesian wells. Saratoga, Baggs, and Dixon divert water from adjacent rivers. The city of Cheyenne, which is outside the ES region, diverts 8,000 ac ft/yr from Douglas Creek, a tributary to North Platte River. The water diverted from Douglas Creek is replaced with an equal amount diverted from the Little Snake River Basin to the North Platte River Basin. The area from which the replacement water is diverted is indicated as a source of municipal supply in Map 6A, even though water from that area does not actually enter the municipal supply system. The city plans to increase their diversion several fold in the next few years (Banner 1976). Laramie also has rights to make similar diversions from the North Platte River and Little Snake River Basins, but have no immediate plans to exercise these rights.

Numerous low yield wells which are capable of delivering generally less than 50 gpm and ponds provide water for stock. Water rights are registered with the Wyoming State Engineer for about 1,200 wells; 700 reservoirs; and over 1,000 BLM water projects within the ES region. Small amounts of industrial water are used by six existing coal mines, the Union Pacific Railroad, and the refinery at Sinclair.

Nonconsumptive uses include recreation such as fishing and boating along the North Platte and on Seminoe Reservoir.

Table R2-10

ESTIMATED WATER USE IN SOUTHCENTRAL REGION

Type of Use		ac ft/yr
Irrigation		167,400
Reservoir Evaporation		
Seminoe	35,100*	
Other Reservoirs	6,600	
		41,700
Municipal		
Rawlins	2,200	
Saratoga	280	
Hanna-Elmo	390	
Sinclair	100	
Medicine Bow	140	
Small communities and rural areas	490	
Total 1977 Use within region	3,600	
Cheyenne	8,000	
Total		11,600
Industrial		1,100
Livestock		1,200
Grand Total		223,000

*From Wyoming State Engineer (1971)

Detailed studies of present water use and potential developments for major river basins of the ES region have been made by the Wyoming State Engineer (1970, 1971, 1973) and Wyoming Department of Environmental Quality (1976a, 1976b).

Groundwater

The principal interest in coal mining is concentrated in two areas having distinct hydrologic characteristics. One area includes the Hanna and Carbon geologic basins, which is termed the Hanna area for purposes of this analysis. The other extends along the western edges of the Great Divide and Washakie Basins from the Rawlins uplift south through Cow Creek and Savery Creek drainages. The northern part of this area is described as the Overland area and the south half is described as the Savery area.

Lowery et al. (1973) divided rocks of the eastern half of the region into eight units according to water bearing characteristics. A summary of characteristics for the eight units is on file in the BLM Rawlins District Office. For this analysis, the classification has been expanded to cover the entire region (see Map 6B in Appendix A). Only small outcrops of units 2 to 4 occur in the region and the units are not differentiated in the western half of the region; therefore, the three units have been combined on the map. Unit 8 consists of alluvial deposits which overlay other units. These deposits were omitted from Map 6B for clarity, but are shown on Map 4.

The principal aquifer systems of the region are found in units 6 and 7. Unit 6 is a series of sandstones that vary from thin discontinuous layers to thick massive ones. It includes the coal bearing Ferris, Hanna, Fort Union, and Mesaverde Formations. Its potential for producing large quantities of water comes from its great thickness, up to 15,000 feet in places, rather than its permeability. Unit 7 is made up of very porous sands and gravels and is capable of producing up to 3,000 gallons per minute (gpm), largely because of its high permeability.

The Hanna and Ferris Formations are the principal coal bearing units in the Hanna area. Both are composed of thin discontinuous lenses of sandstone between layers of shale and siltstone with coal seams interspersed. The principal aquifers are the sandstones and coal. The sandstones are a mixture of material ranging from fine-grained silt to medium-sized gravel. Because of a large amount of fine-grained material, the aquifers have a low coefficient of permeability (hereafter referred to as permeability), on the order of 4 to 5 gallons per day per square foot of aquifer area (gpd/ft^2). Geologic jointing is the principal source of permeability. Shallow wells in these formations generally yield less than 10 gpm. Of four existing surface mines in the Hanna area, only the Medicine Bow Mine intercepts groundwater. The amount of water draining into pits at that mine is 4 or 5 ac ft/yr.

Water is found under water table and artesian conditions. The Hanna area water table is overlain by pockets of perched water that are not connected to the main body of water. Davis (1976 b to e) shows that the water table has a general gradient northward from Hanna toward Seminoe Reservoir (Map R2-7), and concluded that the high water level near Hanna is due to upward movement of water from a deep artesian system rather than from local recharge. Davis places the recharge source at some unknown location to the southeast of Hanna, probably at the base of the Medicine Bow Mountains. The low amount of precipitation and large potential evapotranspiration precludes any significant recharge at the proposed mines. The principal sources of water are deep artesian aquifers. Pressure in the artesian system increases with depth. D'Appolonia (1976) shows a pressure of 500 pounds per square inch (psi) in the northeast quarter of T. 23 N., R. 81 W.

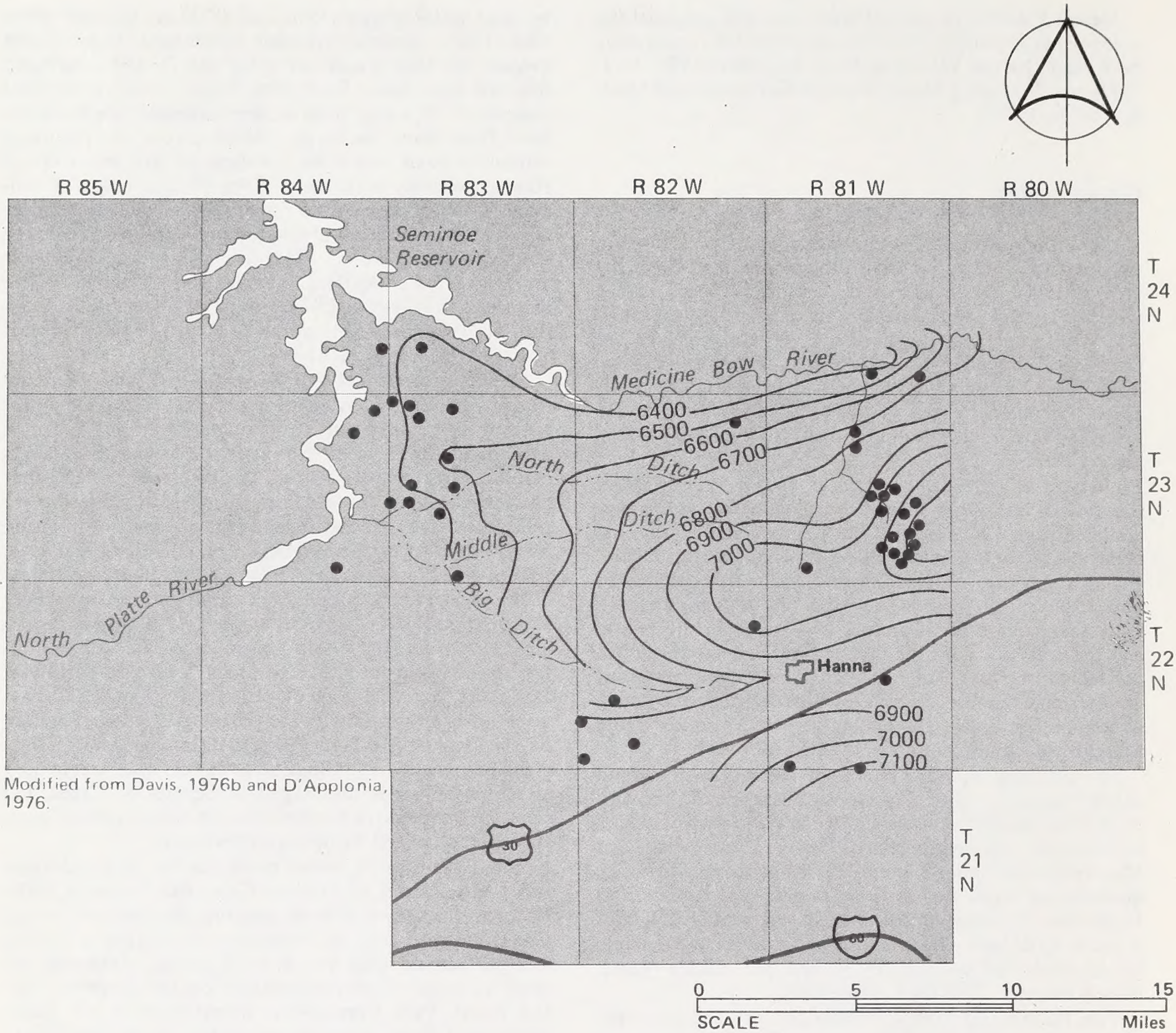
The Mesaverde and Fort Union Formations also consist of alternating layers of sandstone and shale interspersed with coal seams. Continuous layers of sandstone exist in the Mesaverde Formation. Some of the layers reach a thickness of 100 feet (Dobbins et al. 1929), but most are less than 40 feet thick. The sandstone layers are resistent to erosion, and form a narrow band of hogback ridges where the Mesaverde crops out along the west side of the Washakie and Great Divide Basins. Aquifers of the two basins are recharged at the outcrop, especially along Atlantic Rim. The recharge area is shown highly generalized on Map 6A in Appendix A. The general direction of water movement is to the west and northwest along the dip of the geologic strata (Map R2-8), but water also moves downward across the strata. Faulting on the flanks of Atlantic Rim may influence the movement (Davis 1976a). About 90% of the water recharged at Atlantic Rim is discharged to Separation Creek, but small amounts move farther into the Great Divide basin and are discharged by upward movement.

In the Savery area, water moves to the west and south and is discharged to Muddy, Cow, and Savery Creeks. Records from two stream gauging stations on Savery Creek indicate that the formation discharges 0.9 cubic feet per second (cfs) per mile of stream. Recharge appears to come from precipitation on the Brown's Park and North Park Formations, which overlay the Mesaverde, and from streamflow leaving the crystaline igneous and metamorphic rocks of the Sierra Madre.

To the west, the Mesaverde is overlain by the successively younger Lewis Shale, Lance, Fort Union, and Washatch Formations. Welder and McCreevey (1966) and Davis (1976) indicate that the Lewis Shale and Lance Formations are probably aquitards and cause water to occur under pressure in the Mesaverde.

The Fort Union and Wasatch Formations consist of lenticular bodies of sandstone, siltstone, shale, and coal that will support low yield wells. Permeabilities are low, generally ranging from 0.1 to 10 gpd/ft^2. The Fort Union Formation has a massive basal sandstone layer capable of yielding several hundred gpm.

The sedimentary formations all contain some recoverable water, but the variable nature of hydraulic characteristics of the aquifers and lack of data make a detailed analysis of the regional water supply impossible. Estimates of the supply must be based on broad estimates of



Modified from Davis, 1976b and D'Applonia, 1976.

● Well Used In Defining Contours

——— Elevation Of Ground Water Surface

~~~ Perennial Stream

~··~ Intermittent Stream

Note: Elevations represent a composite of water table and artesian levels because of interconnection between aquifers.

Map R2-7

GENERALIZED MAP OF WATER LEVELS IN THE HANNA AREA
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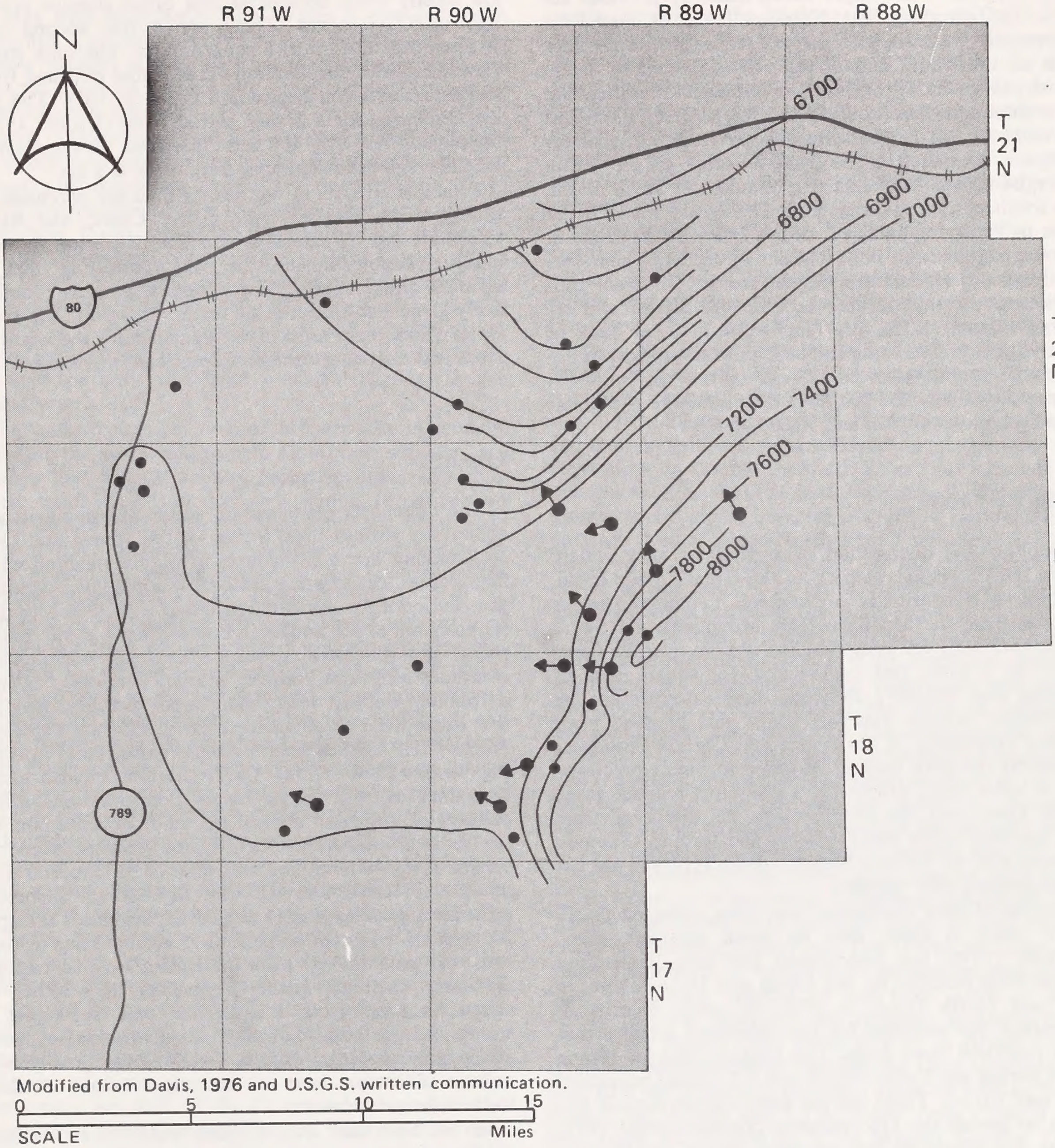


● Well Used in Defining Contours

—6700— Elevation of Ground Water Surface

Spring

Note: Elevations represent a composite of water table and artesian levels because of inter-connection between aquifers

Map R2-8

GENERALIZED WATER TABLE CONTOUR MAP OF THE OVERLAND AREA

water supplies in the major basins made by previous authors. The Wyoming State Engineer (1973) estimated the recoverable water in storage and recharge within those parts of the Platte and Green River (including Great Divide) Basins in Wyoming. The estimates of storage are 3.2 million acre feet (ac ft) in the Platte River Basin and 0.7 million ac ft in the Green River Basin. Annual recharge is estimated to be 210,000 ac ft to the Platte River Basin and 90,000 ac ft to the Green River Basin. The southcentral region includes 21% of the Platte River Basin in Wyoming and 14% of the Green River Basin in Wyoming. However, contributions to recharge and storage from the southcentral region are not in direct proportion to the surface area because the aquifer and recharge characteristics vary from those in other parts of the two major river basins. The estimated amount of recoverable groundwater in storage in the region is between 150,000 and 250,000 ac ft. The recharge is estimated to be between 30,000 and 50,000 ac ft/yr.

Surface Water

Amounts and distribution of streamflow vary widely within the ES region. In parts of the Great Divide Basin, streamflow is essentially nonexistent. Perennial streams draining from the Medicine Bow Mountains and Sierra Madre (see Map 6A in Appendix A) have average flows of 0.5 to 3 cubic feet per second per square mile of drainage area (cfs/mi²). Between these extremes are the intermittent streams that flow only part of each year. Streams originating in the Hanna and Carbon Basins are ephemeral (flowing only in response to direct precipitation or snow melt) except for a few short reaches along Hanna Draw and Big Ditch where the discharge from deep aquifers causes small marshes and springs. Channels are mostly of the vertical-banked arroyo type and are cut in fine-grained, silty material.

Records of peak discharges have been collected for 10 to 15 years at three sites on small drainage areas. Lowham (1976) has summarized the data. Recording gauges were installed on Big Ditch and Hanna Draw in 1975 and North Ditch in 1976; no other records of streamflow are available for the ephemeral streams that drain proposed mine areas. The average flow of Hanna Draw during the 2-year period was 0.5 cfs and maximum flow was 350 cfs. There has not been enough flow in Big Ditch to permit the GS (personal communication 1977) to rate this station so that the stage record can be converted to discharge. On two occasions, peak flows of more than 300 cfs occurred as a result of a thunderstorm. Flows increase rapidly and usually last only a few hours. Some of the smaller streams in the area may flow only once in several years. Most of the streams are now interrupted by stock ponds and mine settling basins.

The Overland area is drained by Separation Creek and Muddy Creek. Each of these streams is reported to have small perennial flows in its headwaters above 7,000 feet, but each stream becomes intermittent further downstream. These two streams are fed by numerous intermittent streams. Streams in the areas proposed for mining are mostly small ephemeral first order streams draining less than 100 acres. There are a few second order streams draining up to 2 square miles. The only streamflow record for the Overland area is that obtained from a station installed on Separation Creek in 1975. The average discharge for a 2 year period from October 1975 to September 1977 is 1.5 cfs (personal communication, USGS). The estimated long-term mean is 2 cfs.

Principal streams in the Savery area are perennial. Although Little Snake River, Slater Creek, and Savery Creek are fed by extensive aquifers, their base flows are highly variable during the year indicating that the aquifers drain rapidly. The perennial streams provide a fairly dependable source of water; however, the use of water from these streams is regulated by the court decrees and interstate compacts described previously.

Quality

The chemicals contained in water determine its suitability for various uses. Water of the Hanna and Overland mining areas is medium to highly mineralized. In many areas, the water is unsuitable for human consumption and poor for agricultural uses (Davis 1976 b to d). It supports only such aquatic life as can exist in intermittent ponds and ephemeral streams. The water contains concentrations of iron, sulfate, nitrate, ammonia, calcium, chromium, copper, lead, manganese, mercury, and zinc that exceed the recommended Environmental Protection Agency (EPA) standards for these constituents in drinking water (BLM 1975a). Concentrations of lead exceed the standards for livestock supply; concentrations of iron, calcium, chromium, manganese, and molybdenum and the sodium adsorption ratio (in one sample) exceed the standards for continuous irrigation. The concentrations of iron (in some samples) and the sodium adsorption ratio (in one well sample) exceed the standards for up to 20 years of irrigation on neutral to alkaline, fine-textured soils. All groundwater from the Hanna area has basically the same chemical quality regardless of whether the sample is taken from a well, mine pit, spoil pile, or spring. All are highly alkaline. Concentrations of minerals in the sporadic surface runoff vary greatly with volume of flow so these concentrations cannot be related to those in groundwater.

In the Overland area, potable water—water suitable for human consumption and having less than 1,000 milligrams per liter (mg/l) of total dissolved solids (TDS)—has been found in shallow aquifers only where these aquifers are recharged near Atlantic Rim (Davis 1976a). Small quantities of potable water are found within 1,000 feet of the surface under Red Rim (Welder and McCreevy 1966). The Atlantic Rim water has less than 1,000 mg/l of dissolved solids, but concentrations of some individual constituents exceed EPA standards. The iron content in most samples exceeded the standard of 1.3 mg/l.

Davis (1976a) and GS (personal communication 1976) found poor water in shallow aquifers throughout most of

the area west of Atlantic Rim. Water is especially high in sulfate. Concentrations of sulfate from water in the shallow aquifers at Red Rim are high enough to have a cathartic effect on humans and some are high enough to cause scours in livestock.

Davis (1976a) found that to a depth of at least 700 feet, the sulfate concentration decreased and water quality improved with increasing depth. The deeper water had a quality comparable to that in the recharge area near Atlantic Rim. Davis concluded that the water leached sulfate and other minerals from the shallow layers of the Fort Union Formation as it moved upward from the deeper aquifers. The normal pH range for the area is about 8 to 9 in both groundwater and surface water. Davis (1976a) found that the base flow of surface streams has approximately the same chemical quality as the groundwater.

The water from areas west of Atlantic Rim is poor for irrigation; the boron and sodium absorption ratios are acceptably low, but the salinity hazard is high. Total dissolved solids and iron are well above recommended Public Health Standards for domestic use. No toxic levels of trace elements or radioactivity were found in either ground or surface water of the Overland area (personal communication, GS 1976).

There is a very marked difference in the chemistry of groundwater from the alluvium of the Savery area and that from the underlying Mesaverde Formation. Water from three wells in the alluvium had a low mineral content with total dissolved solids of less than 600 mg/l; one sample from the Mesaverde had 2,300 mg/l of dissolved solids. Surface water in the area has a chemistry similar to that from the alluvium. The good quality persists in the Little Snake River to the town of Dixon. There is a rapid deterioration in quality downstream from Dixon (Bureau of Reclamation 1976). Biological quality at Dixon is good although there is a potential for contamination by 14,000 head of cattle that are winter fed along the Little Snake River. The Bureau of Reclamation (1976) explains the lack of biological contamination by the fact that the waste can reach the streams only during periods of high runoff resulting from spring snow melt.

Dave Love, geologist with GS Geologic Division (personal communication), has stated that uranium, molybdenum, selenium, and arsenic cause a problem in the water supply and soils of the Savery area. Harmful concentrations of these elements have not been found to date in either groundwater or surface water sampled by GS, Water Resources Division (personal communication, S.J. Rucker), but only a limited number of samples have been tested for the elements. A listing of water quality data furnished by EPA also failed to show any harmful concentrations.

Rosenfeld and Beath (1964) show that the selenium is found in all Cretaceous and Tertiary Formations exposed in the southcentral ES region except the Wasatch, Hanna, and possibly the Ferris Formations. Small amounts of selenium are found in the Lance Formation and Lewis Shale. Only the marine portion of the Mesaverde Formation contains selenium. The selenium content is greatest in the formations that underlie the Mesaverde, especially the Niobrara Formation, Cody Shale, and Steel Shale. The Savery Creek channel intersects the Steel Shale in places (see Map 4 Appendix A). Love (personal communication) states that selenium is evidenced by the presence of certain plants that convert selenium to a soluable form and may concentrate several thousand parts per million in the top few inches of the soil. Water flowing over this soil can dissolve large concentrations of selenium.

Outside the three areas of proposed mining, water quality varies from extremely poor, highly alkaline waters of the Red Desert to water that is suitable for almost any use in streams and alluvium in the mountainous areas. Time weighted averages of total dissolved solids in the North Platte River are 190 mg/l at Northgate, Colorado and 235 mg/l above Seminoe Reservoir. The small change indicates that most of the tributaries to the North Platte, as well as discharging groundwater aquifers, contain dissolved solids in about the same concentrations as the North Platte River, but localized discharges such as those at the hot springs in Saratoga are known to be highly mineralized. Wells throughout the Saratoga Valley in the North Park Formation have total dissolved solid concentrations of less than 500 mg/l except in and near T. 18 N., R. 84 W., where the total dissolved solids run as high as 3,200 mg/l.

Streams in the proposed mining areas carry large amounts of sediment. BLM (1976) computed sediment yield from ten small undisturbed watersheds near Hanna and developed curves relating the yield to watershed slope and percent of bare soil. The computations, made with the Pacific Southwest Interagency Committee (1968) method, showed source yields as great as 1.8 acre feet per square mile per year (ac ft/mi^2/yr); however, seven of ten watersheds had yields of less than 0.5 ac ft/mi^2/yr. Sediment delivery factors ranged from 0.25 to 0.90. The watershed (or basin) yields ranged from 0.1 to 0.3 ac ft/mi^2/yr in the seven watersheds and ranged from .06 to 1.6 ac ft/mi^2/yr in the other three. At two existing mines in Wyoming, Lusby and Toy (1976) produced simulated rainfalls of 1.5 inches in 45 minutes on undisturbed plots of ground ranging in size from 2,000 to 4,000 square feet and measured the resultant sediment yield. The yields ranged from 0.003 to 0.13 ac ft/mi^2. Lusby (personal communication) applied the same techniques at Red Rim and measured sediment yields of 0.02 ac ft/mi^2 from Class A soils and 0.2 ac ft/mi^2 from Class B soils (soil types are defined by BLM Manual, Section 7312).

VEGETATION

Terrestrial

The ES region is dominated by three principal types which comprise about 90% of the vegetative cover. These types are, in order of occurrence; sagebrush, saltbush and greasewood. The remaining 10% is made up of secondary types which include grassland, meadow, mountain shrub, conifer with forage, conifer, barren,

pinon-juniper, aspen, cropland, and river bottom. Type designations and numbers are those used by the Bureau of Land Management (BLM) as described in BLM manuals.

The vegetation of this region is a complex mosaic in which soils, climate, aspect, altitude, and land use are controlling factors in plant distribution. Moisture is often the general limiting factor for the distribution of vegetation. Descriptions of each type follow. Locations are shown on Map 7 in Appendix A.

Grassland, Type 1 (526,500 acres—9.6% of region)

Grassland vegetation occurs as scattered small grass parks and numerous small patches on ridgetops. The type is adaptable to a wide variety of soil types, such as shallow soils of exposed ridges, deep mesa soils, gentle sloping foothill terraces, and on alluvial fans in the valley bottoms. Figure R2-4 depicts a typical grassland area within the region. Grassland areas created by vegetative manipulation, seeding, or wildfires are considered in this type if they are unirrigated.

The grasslands are composed of perennial grasses intermixed with forbs, half shrubs, occasional shrub species, and when in a deteriorated condition, annual grasses. The major forage species found within this type are: western *wheatgrass (Agropyron smithii)*, Indian ricegrass *(Oryzopsis hymenoides)*, needleandthread *(Stipa comata)*, threadleaf sedge *(Carex* filifolia), and Sandberg bluegrass *(Poa secunda)*. Associated species are: bluegrass *(Poa spp.)*, sedge *(Cares spp.)*, brome grass *(Bromus spp.)*, broom snakeweed *(Gutierrezia sarothrae)*, rabbitbrush *(Chrysothamnus spp.)*, and cheatgrass *(Bromus* tectorum). Seeded areas of the grassland type are mostly introduced species (wheatgrass, bromes, and timothy). The ES region contains approximately 526,500 acres of grassland— 9.6%.

Playa Grassland, Type 1A

Scattered through the level to gently sloping upland areas of the northern half of the region are numerous playas (dry lakes) of varying sizes. These playas are seasonally inundated with runoff water from adjacent uplands and have a deep, poorly drained, alkaline-saline soil with a high clay content. The vegetative cover is a distinctive grassland type, and compaction varies with the length and depth of inundation. On the dryer sites, western wheatgrass and foxtail barley *(Hordeum jubatum)* are the dominant species while on the wetter sites, spike rush *(Eleocharis aricularis)* is an important component of the vegetative composition. Figure R2-5 displays the playa located west of the proposed Cherokee project. Playas are not displayed on the vegetative map since their size is smaller than the minimum mappable unit.

Meadow, Type 2 (29,100 acres—0.5% of the region)

The meadow vegetative type occurs wherever abundant moisture is present during the entire year. This includes seeps, springs, and along stream bottoms where the meadow can range from a narrow stringer to a large flat bed area consisting of 80 acres or more. This type is found at all elevations ranging from that at Huston Park (elevation 10,400 feet) in the Medicine Bow National Forest down to the meadows along the Platte and Medicine Bow Rivers (elevation 6,400 feet). The meadow type is a very complex vegetative community. Its composition can vary widely with changes in elevation or locale within an elevation range.

Although this type covers less than 1% of the total acreage of the ES region, it is a very important source of livestock forage as well as forage and cover for both animal and bird wildlife.

The major forage producing species found in this type are tufted hairgrass *(Deschampsia caespitosa)*, western wheatgrass, sedges, Sandberg bluegrass, Great Basin *wildrye (Elymus cinereus)*, and Indian ricegrass. Associated species are: bluegrasses, rushes *(Juncus spp.)*, iris *(Iris spp.)*, and horsetails *(Equisetum spp.)*.

The meadow type is a very complex vegetative community. Its composition can vary widely with changes in elevation or locale within an elevation range. The ES region contains approximately 29,100 acres of meadowland—.5%.

Sagebrush, Type 4 (2,903,000 acres—53% of the region)

The sagebrush type is the most extensive vegetative type in the ES region. Figure R2-6 depicts the dominance of this vegetative type. Wyoming big sagebrush *(Artemisia tridentata* wyomingensus) and basin big sagebrush *(Artemisia tridentata* tridentata) are the most common species present. Other sagebrush species that populate this type are: black *sagebrush (Artemisia nova)*, silver sagebrush *(Artemisia cana)*, birdfoot sagebrush *(Artemisia pedatifida)*, bud sagebrush *(Artemisia* spinescens), and fringed sagebrush *(Artemisia frigida)*.

Grass species dominating in the sagebrush type are: Indian ricegrass, western wheatgrass, Sandburg bluegrass, needleandthread, and bluebunch wheatgrass *(Agropryon spicatum)*. Associated species are: Idaho fescue *(Festuca idahoensis)*, bluegrasses, junegrass *(Koeleria cristata)*, sedges, cheatgrass, arrow balsamroot *(Balsamorhiza sagittata)*, rabbitbrush, and broom snakeweed.

This type can be found adjacent to all other types throughout the region. The growth form is a mixture of low growing shrubs dominated by big sagebrush with a variable understory of perennial grasses and forbs. The annuals fluctuate from year to year depending on spring temperatures and moisture conditions. Type overstory varies from very open to completely closed stands. The ES region contains approximately 2,903,000 acres of the sagebrush type—53%.

Mountain Shrug, Type 5 (105,600 acres—2% of the region)

A typical mountain shrub type supports a dense stand of shrubs 2 to 8 feet in height. It is usually found on

Figure R2-4

EXAMPLE OF VEGETATIVE TYPE 1, GRASSLAND

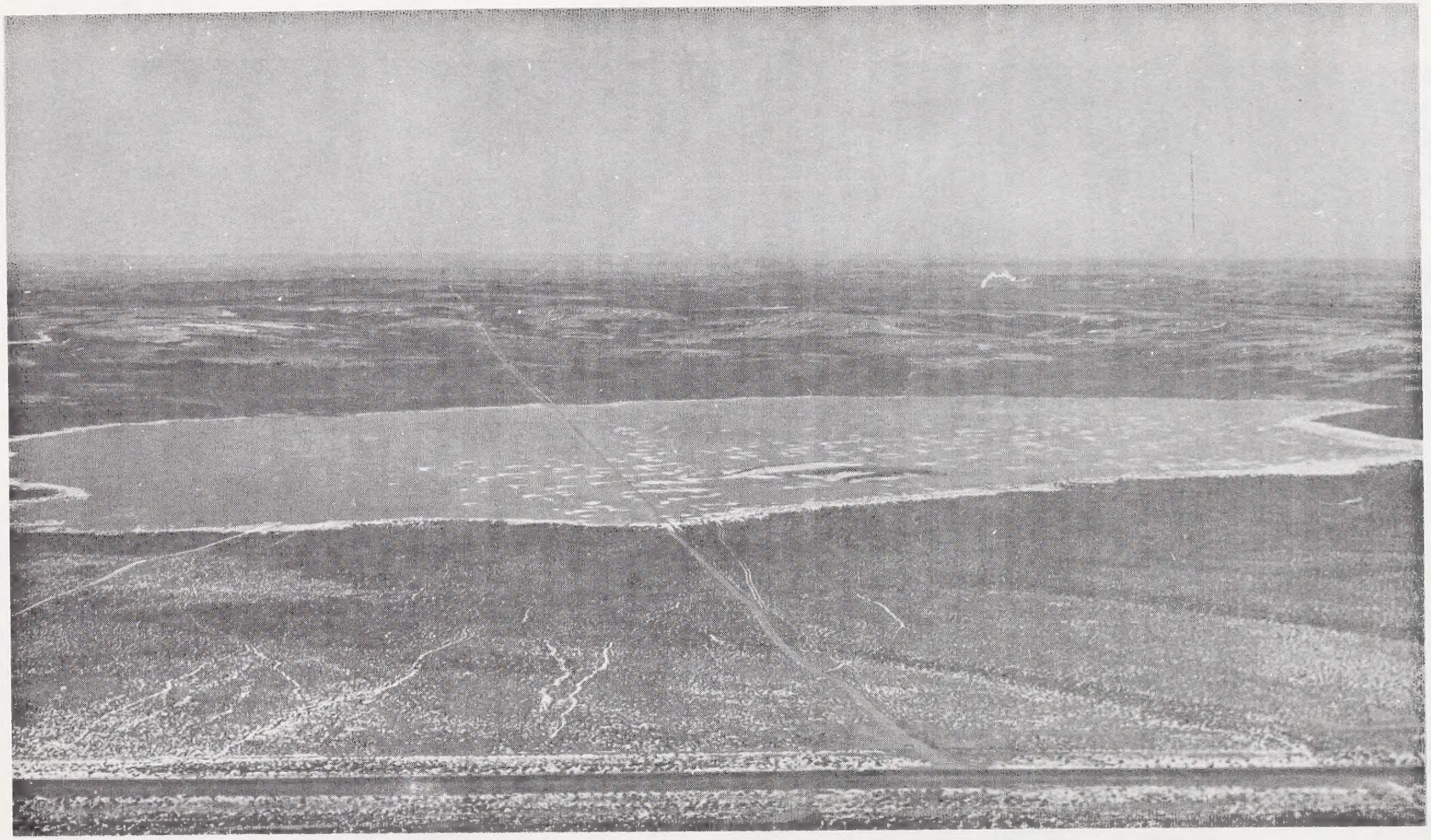


Figure R2-5

EXAMPLE OF VEGETATIVE TYPE 1A, PLAYA

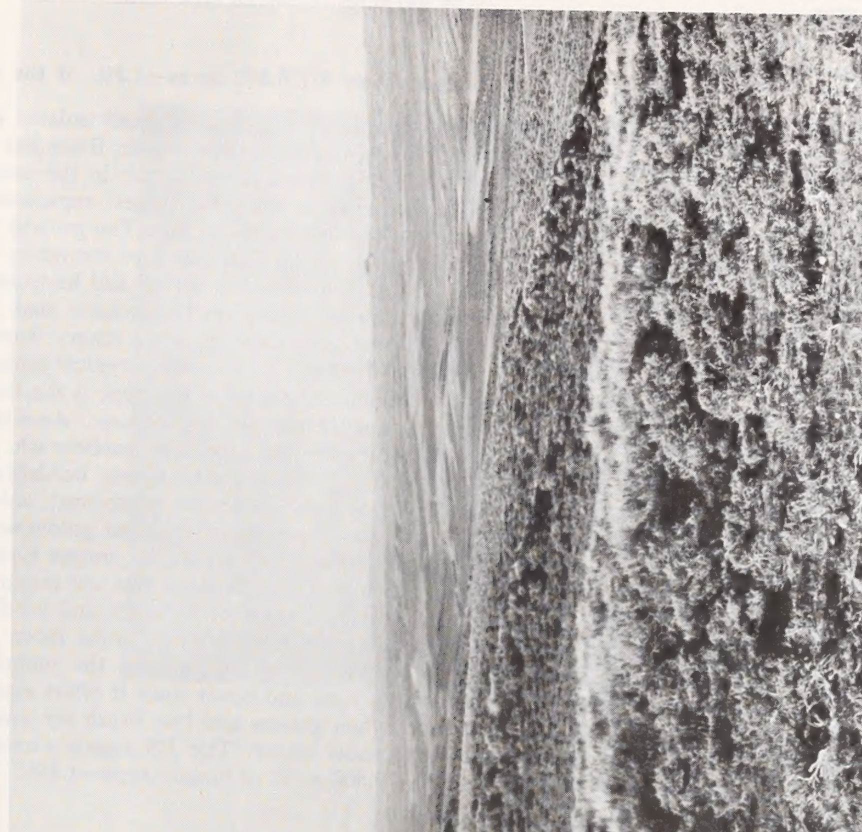


Figure R2-6

LANDSCAPE DOMINATED BY SAGEBRUSH, TYPE 4

slopes, but can occur on any location where soil and moisture conditions are favorable. Figure R2-7 displays typical mountain shrub sites. One of the main characteristics of this type is its variability; no single species is dominant over a very large area.

The primary shrubs found within this type are: mountain mahogany *(Cercocarpus montanus)*, antelope bitterbrush *(Purshia* tridentata), common serviceberry *(Amelanchier alnifolia)*, and snowberry *(Symphoricarpos spp.)*. Associated species are: common chokecherry *(Prunus virginiana)*, gambel oak *(Quercus* gambelii), and big sagebrush. Primary understory species include: Sandberg bluegrass, sedges, junegrass, mountain bromegrass *(Bromus marginatus)*, western yarrow *(Achillea* lanulosa), aster *(Aster spp.)*, and fleabane *(Erigeron spp.)*. Relative forage value of this type depends largely on plant density, species composition, and season of use. It provides important winter range where snow depth does not prohibit access. The cover is essential habitat for deer, elk, and antelope during critical weather periods. The ES region contains approximately 105,600 acres of the mountain shrub— 2%.

Conifer with Forage, Type 6 (23,000 acres—0.4% of the region)

The conifer type is confined primarily to the mountainous areas. It occurs at higher elevations where tree growth conditions are not favorable to producing dense stands of timber, at mid-elevations where soil or moisture conditions limit tree establishment, or on old burns that did not reforest to former standards. Figure R2-8 shows the scattered tree pattern of this vegetative type. The dominant species are: Engelmann spruce *(Picea engelmannii)*, subalpine fir *(Abies* lasiocarpa), and lodgepole pine *(Pinus contorta)*. Primary understory species are: mountain brome, bluegrasses, *pinegrass (Calamagrostis rubescens)*, and timothy *(Phleum alpinum)*. Associated species are: lupine *(Lupinus spp.)*, *eriogonum (Eriogonum spp.)*, fleabane, and aster.

The understory vegetation varies with stand location, density, and stage of succession. Ground cover can vary from dense to nonexistent. Due to the sparsity of vegetative cover, the conifer type is not an important forage source, but it does provide cover for both livestock and wildlife. The ES region contains approximately 23,300 acres of the conifer type—.4%.

Barren, Type 8 (58,300 acres—1.1% of the region)

The barren areas include outcrops, windswept ridges, and other areas where soil, moisture, and climatic conditions are of such severity that only sparse vegetation exists. Low growing, cushion-like plants are major components of the living cover. Figure R2-8 shows examples of exposed sites where the vegetative type occurs.

The dominant species in barren areas are: *goldenweed (Haplopappus spp.)*, sandwort *(Arenaria spp.)*, spiny *phlox (Phlox austromontana)*, fringed sage, and stonecrop *(Sedum* stenopetalum). Associated species are: Sandberg bluegrass, bluebunch wheatgrass; and in the more protected areas; big sagebrush and snowberry. Due to the sparse vegetation, this type has little or no importance as a source of forage. The ES region contains approximately 58,300 acres of barren type lands—1.1%.

Juniper, Type 9 (70,800 acres—1.3% of the region)

The juniper type occurs in small isolated areas in the northeastern portion of the region. Examples of the type become more frequent and larger in the central section of the ES region, while the largest expansion of juniper occurs in the southwestern part. The growth form of this type consists of an 8 to 20 foot overstory of conifers with a thin understory of shrubs and herbaceous species. Juniper can be found on topography that varies from rolling to rugged. Canopy cover ranges from quite open to closed. Figure R2-9 displays a typical juniper site.

The dominant species in this type is the Rocky Mountain juniper *(Juniperus scopulorum)*. Associated understory species are: big sagebrush, rabbitbrush, prickly pear *(Opuntia spp.)*, western wheatgrass, bottlebrush squirreltail *(Sitanion hystrix)*, broom snakeweed, antelope bitterbrush, Indian ricegrass, phlox, and goldenweed. Considerable variation exists within the juniper type, depending upon soil moisture conditions and soil texture. The open stands provide forage for livestock and wildlife, whereas closed stands usually provide little more than cover. During critical weather periods, the juniper type provides both food and cover since it offers essential survival food when grasses and low brush are unavailable due to deep snow cover. The ES region contains approximately 70,800 acres of juniper type—1.3%.

Aspen, Type 10 (164,900 acres—3% of the region)

The aspen type occurs as open to very dense stands of deciduous trees at higher elevations. The trees are often clonal in habit, sharing a common root system. The type generally occurs along drainage bottoms and in isolated small patches except on the western slopes of the Sierra Madre Range of the Medicine Bow National Forest. The aspen type which stands on these slopes is extensive and is considered to be the largest expansion of aspen in the state of Wyoming. Growth characteristics can vary from dwarfed and twisted stands on snow accumulation sites to merchantable class stands on the more fertile sites in the national forest. Owing to its sprouting characteristic, aspen reproduces vigorously in cutover or burned areas of the conifer type if parent stock is present. Figure R2-10 depicts typical aspen patches that are common throughout the mountainous areas.

The dominant species of this type is quaking aspen *(Populus* tremuloides). Associated species are: aspen peavine *(Lathyrus* leucanthus), timothy, mountain brome, geranium *(Geranium spp.)*, snowberry, mountain ninebark *(Physocarpus monogynus)*, bluegrass, wheatgrass, carex, cowparsnip *(Heracleum lanatum)*, *larkspur (Delphinium spp.)*, and many others that make up this complex and varied pland community. This type is important for the

Figure R2-7

MOUNTAIN SHRUB VEGETATION (TYPE 5)

Figure R2-8

EXAMPLES OF VEGETATIVE TYPES; MOUNTAIN SHRUB (TYPE 5) DOMINATES PROTECTED DRAWS AND IS BORDERED BY SAGEBRUSH (TYPE 4), SMALL AREAS OF BARREN (TYPE 8) ON EXPOSED SITES ON UPPER PART OF RIM, ISOLATED AREA OF CONIFER WITH FORAGE (TYPE 6) IN FOREGROUND

Figure R2-9

VEGETATIVE TYPE 9, JUNIPER

Figure R2-10

ASPEN (TYPE 10) AND LODGEPOLE PINE (TYPE 63) VEGETATIVE TYPES; NOTE INTERMIX OF THE TWO TYPES IN FOREGROUND WHILE PICTURE MIDGROUND SHOWS PURE STANDS OF THE ASPEN (LIGHT COLOR) AND LODGEPOLE PINE (DARK COLOR)

production of water, shelter for livestock and wildlife, and for forage production, especially in the western mountain slope region. The ES region contains approximately 164,900 acres of the aspen type—3%.

Saltbush, Type 13 (474,500 acres—8.7% of the region)

Saltbush is the second most extensive type. It occurs as mixed stands of low growing shrubs with a grass-forb understory. The understory vegetation exhibits considerable variation, since poor stands often have a high percentage of annual grasses in contrast to those in good condition which exhibit a complex mixture of perennial grasses and forbs. The ability of the sagebrush type to compete with other vegetation is probably the major limiting factor to the extent of the saltbush type. Figure R2-11 depicts a typical saltbush site in the region.

Dominant species of this type are: Nuttall *saltbush (Atriplex nuttallii)*, shadscale *(Atriplex confertifolia)*, fourwing saltbush *(Atriplex canescens)*, and mat *saltbush (Atriplex corrugata)*. Associated species are: big sagebrush, black sagebrush, Indian ricegrass, western wheatgrass, Sandberg bluegrass, bottlebrush squirreltail, halogeton *(Halogeton* spp.), broom snakeweed, and cheatgrass.

The saltbush type is generally regarded as valuable winter range for live-stock and wildlife, but does receive grazing use throughout the year. The ES region contains approximately 474,500 acres of the saltbush type—8.7%.

Greasewood, Type 14 (350,200 acres—6.4% of the region)

The greaswood type is the third most extensive type in the region. This type is characteristically found in low areas where surface water gathers, on areas at the edge of meadows that receive excessive irrigation water, and in alkaline soil situations.

The primary dominant species of this type is black greasewood *(Sarcobatus vermiculatus)*. Other shrubs that occur in more open stands are rabbitbrush, fourwing saltbush, Nuttall saltbush, and big sagebrush. Associated species are: western wheatgrass, bottlebrush squirreltail, Indian ricegrass, Sandberg bluegrass, carex, and cheatgrass.

The greasewood plant provides little forage for livestock and is a poisonous plant if grazed in sufficient quantities. The ingestion of a moderate quantity of this plant by bred cattle can cause them to abort their young. The associated plant species do provide a limited amount of forage for livestock and wildlife. Figure R2-12 depicts a typical greasewood-sagebrush association. The ES region contains approximately 350,200 acres of the greasewood type—6.4%.

Cropland, Type 19 (175,400 acres—3.2% of the region)

The croplands of the ES region are composed of natural meadows, subirrigated valley bottoms, and adjacent mesas and slopes along the river basin. Also included are upland areas that have been farmed but abandoned, or seeded to introduced species of grasses. Areas immediately adjacent to rivers and streams are used for hay production. Figure R2-13 displays a hay meadow of this type. Mesas and foothill slopes are generally used for production of small grains, mostly winter wheat *(Triticum aestivum)*, by the summer fallow method (Figure R2-14). The haylands are composed mostly of bromes, timothy, wheatgrasses, orchard grass *(Dactylis glomerata)*, ryes *(Elymus* spp.), sweet clovers *(Melilotus spp.)*, and alfalfa *(Medicago* spp.).

The areas are limited in production by a short growing season and short supply of seasonal moisture from either natural precipitation or, in some cases, irrigation water. It is estimated that 90% of the cropland acreage is managed under an irrigation system. Most of the areas used for small grain production were formerly sagebrush lands which, for the most part, are unprotected against wind and water erosion. Croplands provide a significant amount of forage for livestock during times when grazing lands are unavailable. The ES region contains approximately 175,400 acres of cropland—3.2%. It is estimated that 90% of the cropland acreage is managed under an irrigation system.

Riparian, Type 20 (57,400 acres—1.1% of the region)

This type occurs along main drainages. It essentially occurs along the entire length of the rivers, but in many areas is too small to be differentially classified from the surrounding vegetative types. Included in this type are groves of deciduous trees, marshlands, open grasslands, and rocky canyons with very little vegetation. Figures R2-13 and R2-14 display a typical riverbottom site along the Platte River.

Groves of trees included in this type contain mostly narrowleaf cottonwood *(Populus angustifolia)*, and a small amount of boxelder *(Acer negundo)*. Associated species are: willow *(Salix spp.)*, dogwood *(Cornus spp.)*, hawthorn *(Crataegus* spp.), bluegrass, wheatgrass, bromes, rushes, sedges, and in the poorly drained marshy areas, cattails *(Typha latifolia)*.

Many areas of this type have been converted to croplands, usually hay production, with the result that only fringe strips remain along the stream banks. The riparian type is essentially the area between the summer low water level and the spring runoff flood level. It may also be subject to periodic flooding from flash thunderstorms. The riparian areas provide valuable nesting areas for raptors and other birds, as well as food and cover for many species of wildlife.

The ES region contains approximately 57,400 acres of the riparian type—1.1%; none occurs within any of the proposed sites.

Conifer, Type 63 and 64 (399,500 and 128,300 acres)

The timber type vegetation is generally confined to higher elevation mountainous areas. Growth characteristics vary from thick stands of pole timber, 100 or more

Figure R2-11

SALTBUSH VEGETATIVE TYPE (TYPE 13)

Figure R2-12

EXAMPLE OF GREASEWOOD VEGETATIVE TYPE (TYPE 14), WHICH DOMINATES SITE AS INDIVIDUAL SHRUBS AND IN STRIPS ON SOILS OF HIGH SALINITY

Figure R2-13

RIPARIAN VEGETATION (TYPE 20) OCCURRING ALONG NEW AND OLD STREAM CHANNELS; AN AREA OF CROPLAND (HAYLAND) IS SHOWN ON LEFT SIDE OF PICTURE; THIS CROPLAND IS MANAGED UNDER IRRIGATION FARMING METHODS

Figure R2-14

CROPLAND (TYPE 19) MANAGED UNDER DRYLAND FARMING METHODS

Figure R2-15

CONIFER--TYPE 63

years of age, to open stands of commercial quality sawtimber. The coniferous forests of the mountains are the primary source of logs for the lumber industry in the Saratoga Valley, and also provide posts, poles, firewood, and other miscellaneous products to meet the demands of the local populace.

The two primary types are the lodgepole pine (type 63) and the spruce-fir (type 64). Figure R2-15 shows the lodgepole pine type as a pure stand or intermixed with aspen. Associated species with the lodgepole pine are: subalpine fir, quaking aspen, huckleberry *(Vaccinium spp)*, heartleaf arnica *(Arnica* cordifolia), pinegrass, common juniper *(Juniperus communis)*, wildrye grass *(Elymus spp.)*, barberry *(Berberis spp.)*, and lupine.

In the spruce-fir type, Engelmann spruce is dominant and subalpine fir is subdominant. Associated species are: quaking aspen, huckleberry, heartleaf arnica, geranium, currant *(Ribes* spp.), pyrola *(Pyrola spp.)*, marshmarigold *(Caltha leptosepala)*, and senecio *(Senecio spp.)*.

Ground cover under dense stands is composed entirely of litter (conifer needles, leaves, etc.). This vegetative type has very little forage value, but does provide essential cover for wildlife species.

Endangered and/or Threatened

About half of Wyoming's endangered or threatened plants grow on limestone derived soils. These are primarily on rocky limestone ridges and slopes. The remaining half grow in a variety of habitats, including meadows, rocky slopes and ridges, granite rock crevices, juniper forest, clay flats, and barren hills. Some of these habitats have very unusual soil types to which the plants are restricted. The plants in the more common habitats are rare for other unknown reasons probably involving poor productive or dispersal ability. Common habitats like sagebrush or greasewood almost never contain endangered or threatened plants.

Most endangered and threatened plants would not occur in the coal areas on the basis of known distribution and habitat requirements. Only three species, *Physaria condensata*, *Arabis* demissa, and *Sphaeromeria simplex*, would be expected in the southcentral coal areas. All of these are found on limestone.

The southcentral coal areas were surveyed for endangered or threatened plants (Wyoming listing) from May 3, 1977 to July 3, 1977 by Robert Dorn, BLM botanist. No threatened or endangered plants were found. Most of the coal area is overlain with sandstone or sand. This is a very rare habitat for endangered or threatened plants in this region. It was concluded that the chance of any endangered or threatened plants being present is near zero (BLM Memos 4510 (932) dated July 22, 1977 and August 15, 1977).

No endangered and/or threatened plant species as listed by the U.S. Fish and Wildlife Service are known to exist in the southcentral region (personal communication, Bruce McBride, U.S. Fish and Wildlife Service, Endangered Species Office, Washington, D.C., August, 1978).

Reclamation

Reclamation activity on coal mines in the ES region is fairly recent (see soil mapping unit 53). The Open Cut Law of 1969 and the Environmental Quality Act of 1973 were among the first laws establishing regulations for reclamation in Wyoming. The reclamation activity has generally been on trial and error basis and has not been very successful. This lack of successful reclamation is due in part to poor reclamation practices. The short time frames involved in reclamation activity, and the absence of any previous good reclamation efforts in the area to guide new efforts. Examples of poor reclamation practices are the failure to separate and bury unsuitable overburden (carboneous shale, parting material) material beneath suitable overburden material, replacement of insufficient topsoil amounts, lack of contouring, lack of shrub replacement (started in fall 1976), lack of fencing to control grazing by livestock and wildlife, and lack of mulching. Other important variables are the severe climatic conditions; low precipitation, low humidity, 80 to 100 day growing season, and sustained high winds. Since 1975, the coal companies' reclamation efforts have been improving, and have been conducted under regulations existing prior to the new SMCRA regulations. Past reclamation efforts have resulted in areas in various stages of revegetative development, but to date DEQ has not released any area in the ES region as being completely reclaimed. An estimated 3,653 acres are in the process of being reclaimed through initial seeding on five of the six existing mines in the Hanna Basin area. Reclamation procedures are expected to be improved considerably and reclamation success increased substantially with the application of the SMCRA regulations.

FISH AND WILDLIFE

General Information

Habitat Types

Primary vegetative habitat types found in the region and the major species of wildlife that occur in these various types are listed below. A partial listing of wildlife species that could occur in the region can be obtained from the Rawlins District Office of the BLM.

Aquatic

There are approximately 1,270 miles of cold water, high-quality trout streams in the region plus an unknown number of miles of small flowing streams and intermittent small tributaries which support only nongame fish or do not support any fish life at all. In addition to flowing water, there are an estimated 17,000 to 31,000 acres of lakes and reservoirs located in the region outside the boundary of the Medicine Bow National Forest. These

waters support rainbow trout, brook trout, brown trout, cutthroat trout, mountain whitefish, walleye pike, carp, Utah chubs, lake chubs, speckled dace, sand shiner, bigmouth shiner, Bonneville redside shiner, Iowa darter, Johnny darter, fathead minnow, longnose sucker, white sucker, flannel mouth sucker, and sculpins.

Terrestrial

Sagebrush (2,903,000 acres). This vegetative type supports a great variety of wildlife species including pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, badger, coyote, longtail weasel, deer mouse, least chipmunk, Richardson's ground squirrel, bobcat, Brewer's sparrow, vesper sparrow, sage sparrow, sage grouse, green-tailed towhee, and horned larks.

Conifer (551,100 acres). This type does not, in reality, support wildlife, but furnishes valuable cover to mule deer, elk (Wapiti), bighorn sheep, black bear, red fox, mountain lion, blue grouse, downey woodpecker, and mountain bluebirds.

Grassland (526,500 acres). This habitat supports pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, deer mouse, coyote, badger, and longtail weasel.

Saltbush (474,500 acres). This vegetative habitat supports much the same species of wildlife as does sagebrush so the species list for this type is the same as that for sagebrush.

Greasewood (350,200 acres). This type supports pronghorns, mule deer, desert cottontail, whitetail jackrabbit, whitetail prairie dog, coyote, badger, red fox, and virtually the same bird species found in the sagebrush type.

Aspen (164,900 acres). This important type furnishes both food and cover for mule deer, elk (Wapiti), black bear, bighorn sheep, coyote, blue grouse, and mountain bluebirds.

Mountain Shrub (105,600 acres). This is also an important type since it supports mule deer, elk (Wapiti), red fox, coyote, striped skunk, badger, longtail weasel, deer mouse, least chipmunk, and golden mantled ground squirrels.

Juniper (70,800 acres). This vegetative type supports pronghorns, mule deer, cottontail rabbits, Uinta ground squirrel, deer mouse, mountain lion, bobcat, coyote, red fox, longtail weasel, horned larks, rock wren, sage thrasher, and Brewer's sparrow.

Riparian (57,400 acres). This important wildlife habitat type supports long and shorttail weasels, badgers, skunks, coyotes, red fox, beaver, mink, whitetail deer, ferruginous hawks, redtail hawks, osprey, American kestrel, great horned owl, black crowned night heron, great blue heron, kingfisher, ducks of many species, killdeer, sandpipers, bank swallow, tree swallow, and black phoebe. Bald eagles also winter in this habitat type, but are not known to nest in the region. For acreages of other vegetative types in the region, refer to the Vegetation section in this chapter.

Raptors. Many species of raptors can be seen hunting in one or several of these habitat types. They include Swainson's hawk, red-tail hawk, ferruginous hawk, marsh hawk, American kestrel, prairie falcon, turkey vulture, golden eagle, great horned owl, and burrowing owl.

Fishery

Introduction

There are about 1,270 miles of streams and 17,000 to 31,000 acres of lakes and reservoirs in the region supporting both game and nongame fishes (Wyoming Game Fish Department 1977d). Major aquatic habitat in the region includes the North Platte River, Little Snake River, Medicine Bow River, and numerous tributaries. Seminoe Reservoir, which lies on the northern boundary of the region, and many other small reservoirs and stock ponds also furnish aquatic habitat in the region.

Nongame

The most important fisheries close to any proposed mining operation are the Medicine Bow River and Seminoe Reservoir. The primary nongame fish species present in these two areas are creek chub, longnose dace, speckled dace, white sucker, longnose sucker, Johnny darter, Iowa darter, fathead minnow, carp, and sculpins (Wyoming Game and Fish Department 1977d). The best population density estimate currently available is about 20 pounds of nongame fish per acre in the Medicine Bow River. Similar data are not currently available for Seminoe Reservoir.

Game

Both the Medicine Bow River and Seminoe Reservoir support populations of game fish. Sport fish present are rainbow trout, brown trout, brook trout, and walleye. Fishing pressure estimates for the Medicine Bow River are three fisherman days per mile of stream annually while sport fishing days on Seminoe Reservoir are estimated to be 1.6 fisherman days/surface acre annually. The quality of fishing at the present time indicates that the Medicine Bow River could support nine fisherman days per mile of stream while Seminoe Reservoir could support 15.8 fisherman days/surface acre annually. Refer to the Recreation Resources section for a more complete discussion of the recreational use of fisheries in this area.

Sensitive Species

The ES region contains one variety of cutthroat trout which is officially listed with the Wyoming Game and Fish Department and the BLM as sensitive. This category includes species classified by these agencies as one that could face the potential of extinction. The variety

listed is the Colorado River cutthroat *(Salmo clarki pleuriticus)*. The present status of this fish is best classified as "depleted"(Binns 1977). This trout is found primarily in isolated tributaries to the Little Snake River.

Wildlife

Introduction

The primary habitat types in the region consist of sagebrush (2,902,000 acres), conifer (551,100 acres), grassland (526,500 acres), saltbush (474,500 acres), greasewood (350,200 acres), aspen (164,900 acres), mountain shrub (105,600 acres), juniper (70,800 acres), and riparian (59,400 acres). A summary of seasonal ranges for all wildlife is shown in Table R2-11.

Birds

Nongame. The principal songbird species found in the region are listed under major habitat types at the beginning of this section. The best field data presently available indicate that there are about 21 nesting pairs of small birds per 100 acres in the vegetative types found in the region (personal communication, Max Schroeder, USFWS, March 1978).

Southcentral Wyoming contains abundant raptor nesting habitat in the form of cliffs for nesting and large, open basins near these cliffs for hunting. Large concentrations of both bald and golden eagles can be found in the region during the winter, although bald eagles are not known to nest here.

Game. The major game bird species found in the region is the sage grouse. Except for heavily timbered areas such as the Medicine Bow National Forest, these grouse are generally found throughout the ES region in association with sagebrush vegetation. There are three crucial habitat niches that are necessary for continued survival of this species; strutting grounds (or leks), nesting and brooding habitat, and winter concentration areas (see Map 8A, Appendix A).

The sage grouse is the major upland game bird found in Wyoming. The importance of this species to the state is indicated by the fact that an estimated 17,251 hunters took to the field after sage grouse in 1977 and 14% of these hunters (2,470) pursued their sport in the southcentral ES region. Hunters in the ES region harvested an estimated 11,925 sage grouse in 1977 or 17% of the statewide total. Economically, the sage grouse is very important since an estimated $122,596 was spent by sage grouse hunters in 1977 in the region (Table R2-12).

During the spring, summer, and fall, mourning doves are commonly found in the region in all vegetative types except at higher elevations. During August and September, they migrate south out of the state.

Ducks and geese in the region are mostly migratory and during the spring and fall migrations many water areas in the region are used for resting. Some waterfowl nesting takes place in rivers, streams, reservoirs, and stock ponds, but the region cannot be classed as a waterfowl production area.

Rare Species. There appears to be only one bird found in the region that is listed by the Wyoming Game and Fish Department and the BLM as being rare. This bird is the burrowing owl.

A bird that is not listed as either rare or endangered is the golden eagle. However, because of its inclusion in the Bald Eagle Act, the species must be considered as possibly being impacted by energy related activities. Several active nests of this species are known to occur on some of the site specific areas that are being considered in this ES.

Mammals

Nongame. A large variety of furbearers and predators can be found in the region. Skunks and raccoons are quite common, especially near agricultural areas. Although bobcats were common in the past, the high price of pelts the past several years has led to indiscriminate trapping which has caused a population decline for the past several years. The coyote is abundant and is increasing.

Other small mammals that are found in the region are longtail weasels, red foxes, badgers, whitetailed prairie dogs, least chipmunks, deer mice, and whitetailed jackrabbits. A listing of mammals that, according to the literature could occur in the region can be found in the Wyoming Game and Fish Report (1977d).

Game. See Map 8A in Appendix A for distributions of all big game species inhabiting the region.

Pronghorn. Pronghorns are the most conspicuous wildlife species in the region. An estimated population of 30,000 to 44,000 pronghorns range over the entire region with the exception of the coniferous Medicine Bow National Forest.

The importance of the pronghorn to the region cannot be overemphasized. In 1977, an estimated 4,134 resident and 3,192 nonresident hunters stalked pronghorns in the region, taking an estimated 6,963 animals, while spending a total of $1,095,726 in pursuit of this unique trophy (see Table R2-12).

The contribution of the total pronghorn harvest in the region to the state total harvest is considerable since the total regional harvest in 1977 was about 12% of the total Wyoming state harvest.

Mule Deer. Mule deer are distributed throughout most of the region due to an abundance of good habitat. Regional deer populations appear to have recovered from the severe declines of the late 1960s and early 1970s and the estimated population of 17,000 to 21,500 animals is the result of a slightly but continuously, increasing population.

Second only to the pronghorn, the mule deer is a very important trophy and game species in the region. In addition to its trophy value, the mule deer is of significant importance to the region both in numbers of hunters who come here to pursue the elusive "mulie"and in number harvested.

Table R2-11

SEASONAL RANGES AND POPULATION STATUS OF MAJOR WILDLIFE SPECIES WITHIN THE REGION

	Summer Range (Acres)	Winter Range (Acres)	Crucial Winter Range (Acres)	Year-Round Range (Acres)	Crucial Nesting (Acres)	Total Acres*	% of Study Region	Pop. Status	Present Pop.
Mule Deer	1,186,500	1,049,500	363,000	997,100		3,596,100	66	Increasing Slightly	17,000 to 21,500
Whitetail Deer				84,700		84,700	1.5	Increasing	200 to 250
Pronghorn Antelope	2,714,600	966,155	829,600	929,700**		4,624,300	84	Stable	34,000 to 40,400
Elk	745,000	311,877	158,200	86,200**		1,077,060	20	Stable to Increasing Slightly	5,500 to 7,500
Bighorn Sheep				100,700		100,700	1,8	Increasing	200 to 345
Sage Grouse	989,100		195,000	2,761,900*	316,900	4,208,500***	77	Stable to Decreasing Slightly	---
Blue Grouse****	40,000			648,200		688,200	13	Stable	---
Trout	1,270 miles of streams 17,000 to 31,000 acres of lakes								
Raptors*****								Unknown	Unknown

*Indicates only total range available, overlapping acreages will total more than available range.
**Includes habitat utilized as yearlong and/or winter range.
***Excludes 54,500 acres of crucial winter and crucial nesting habitat overlap.
****General range.
*****A survey of raptor nesting sites is presently underway in the region (1978).

(Population numbers and status information based on communication with the Wyoming Game and Fish Department 1978; and U.S. Department of Interior (BLM)

Table R2-12

TOTAL HUNTERS, HARVEST AND ECONOMIC VALUE OF MAJOR GAME SPECIES, 1975-1977, SOUTHCENTRAL ES REGION

Species	Year	Total Hunters*		Total Expenditures**		Total
		Resident	Nonresident	Resident	Nonresident	Harvest
	1975	2,929	3,213	$229,165	$768,264	5,879
Pronghorn	1976	3,362	3,091	$298,411	$1,394,031	5,698
	1977	4,134	3,092	$314,526	$781,200	6,963
	1975	2,774	1,430	$286,487	$502,942	2,290
Mule Deer	1976	5,204	1,821	$505,167	$766,675	3,611
	1977	7,318	2,903	$523,972	$550,120	5,448
	1975	5,906	298	$966,019	$233,868	1,964
Elk	1976	9,280	477	$1,456,477	$438,525	1,884
	1977	9,878	398	$1,058,065	$183,724	2,215
	1975	2,135***		$102,429***		9,826
Sage Grouse	1976	2,265***		$116,285***		11,054
	1977	2,470***		$112,596		11,925

*Number of hunters and total harvest data from Wyoming Game and Fish Department Annual Reports of Big Game Harvest by year.

**Total estimated expenditures by hunters taken from Hunting and Fishing Expenditure Values and Participation Preferences in Wyoming, 1975 and yearly updates.

***Numbers of hunters and expenditures are not broken into resident and nonresident categories for small game harvest data.

In 1977 about 10,221 hunters came to this region to hunt mule deer. These hunters took an estimated 5,448 deer. In addition to the food value of the harvested animals, hunters spent an estimated $1,074,092 during the fall season in pursuit of their sport (Table R2-12), a very important economic boost to the region.

Whitetail Deer. Whitetail deer are found in the riparian and agricultural zones along the North Platte River from Saratoga to Seminoe Reservoir and in the Rock Creek drainage between Arlington and McFadden. The Wyoming Game and Fish Department estimates the regional population to be increasing with present numbers between 200 and 250 animals.

Elk (Wapiti). Several elk herds occupy suitable habitat in the region. The majority of these animals use migration corridors between the Medicine Bow National Forest and lower elevations for winter range while some elk are yearlong residents in lower areas. Estimates by the Wyoming Game and Fish Department place regional numbers between 5,500 and 7,500 animals with a stable to slightly increasing population.

While not present in the numbers of other big game species in the region, the elk is, nevertheless, an important fixture in both the ecology and economy of the region. In 1977, a total of 9,878 resident and 398 nonresident elk hunters spent $1,241,789 on their elk hunt in the region, taking an estimated 2,215 animals (Table R2-12).

Bighorn Sheep. Bighorn sheep were reintroduced into the region in 1970 with a plant near Savage Run on the North Platte River. This population has now extended its range to include the Bennett Peak area. In 1976, additional sheep were released in Encampment Canyon, south of the town of Encampment. Estimates by the Wyoming Game and Fish Department place the present populations at 200 to 345 animals.

Limited hunting seasons have been held in the Douglas Creek area since 1975. Eighteen hunters have harvested an estimated eight sheep while spending about $22,501 for a chance to hunt these prized trophy animals.

Black Bear and Mountain Lion. Both the black bear and mountain lion are found in the region, but populations of both are thought to be small. Evidence of the small population size can be inferred from the 1977 estimated black bear harvest of 163. At the same time, no lions were taken in the region.

Cottontail Rabbits. There are two species of cottontail rabbits found in the region, the mountain cottontail found in sagebrush and mountain shrub areas and the desert cottontail found in the more open plains and desert areas. The two species furnish considerable hunting for many people as evidenced by the 1977 total of 1,524 hunters who took an estimated 15,591 cottontails in the region. These hunters spent an estimated $47,092 in the region hunting these abundant animals.

Reptiles and Amphibians

General

The principal reptiles found in the region include the northern plateau lizard, eastern shorthorned lizard, northern side-blotched lizard, wandering garter snake, great basin gopher snake, and prairie rattlesnake. There are at least twelve species of reptiles occurring in the region.

The primary amphibians found in the region are the Utah tiger salamander, Rocky Mountain toad, and leopard frog. There are at least ten species of amphibians found in the region.

Sensitive Species

The booklet "Current Status and Inventory of Wildlife in Wyoming", published by the Wyoming Game and Fish Department, lists the Rocky Mountain rubber boa and the western smooth green snake as rare species in this area. Neither of these species is known to occur on or near any of the site specifics covered by this document.

Feral (Wild) Horses

The ES region had a January, 1978 feral horse population of approximately 1,355. There were about 725 horses in the Adobe Town area and 630 in Atlantic Rim horse study area which includes the Cherokee Mine site (see Table R2-13 for a summary of inventory data).

Estimates of feral horse reproduction made by Bureau of Land Management personnel place the average annual increase at approximately 20%. Management Framework Plans call for all horses to be removed from the checkerboard area and then yearly removal of drift animals. These plans also call for stabilization of the horse population to about 400 head in the Adobe Town area and 200 in the Cherokee area.

Development of natural resources, such as coal and uranium mining and oil and gas drilling, appears to have little effect upon horses and it is not uncommon to find horses grazing near these developments.

Feral horses compete with elk for winter forage and with all wildlife species for water, especially during periods of low availability (feral horse distribution is detailed on Map 9, Appendix A).

Endangered and/or Threatened

Since there are large populations of whitetail prairie dogs in the region, habitat exists for the black-footed ferret. There have been eighteen confirmed sightings of the ferret in the region since 1970. The BLM has contracted with the USFWS for an intensive search for ferrets: it will be conducted in the region during August and September, 1978. A final report on the inventory will be available in October, 1978.

Bald eagles winter in large numbers along the Platte River, Medicine Bow River, Rock Creek, and the Little

Table R2-13

SUMMARY OF FERAL HORSE INVENTORY DATA

Inventory Date	Total Number Horses Counted	Mature Studs	Mares	Number of Colts	Bands	Average Band Size
ADOBE TOWN STUDY AREA						
1974 Winter	647	-----	-----	-----	-----	-----
1975 Winter	881	-----	-----	80	61	-----
1976 Winter	1,002	-----	-----	130	160	9.5
1977 Winter	725					
ATLANTIC RIM STUDY AREA						
1974 Winter	517	-----	-----	30	101	5.1
1974 Summer	536	-----	-----	84	83	6.5
1975 Winter	625	-----	-----	73	95	6.6
1976 Winter	667	-----	-----	99	99	7
1977 Winter	630*					

*300 horses rounded up in late fall of 1977 and removed from area, but are included in the 630 total (these horses were placed through the Adopt-a-Horse program).

Snake River during the months of January and February. These wintering areas cover an estimated 180,574 acres. There have also been four reports of peregrine falcons in the region since 1970 (see Map 8A, Appendix A).

At the present time there are no known federally listed threatened or endangered fishes, reptiles, or amphibians occurring in the southcentral coal ES region.

All surveys for threatened or endangered species covered not only proposed mine sites, but also included an appropriate buffer zone around the sites.

CULTURAL RESOURCES

Archeological

Archeological investigations in the southcentral region have been scattered and sporadic until recently. Many of the recent cultural resource investigations in the ES region have been undertaken to comply with Section 106 of the Historic Preservation Act of 1966, and Section 2(b) of Executive Order 11593, "Protection and Enhancement of the Cultural Environment". These inventories, together with earlier efforts, have been important in developing a chronology for this region, which is a part of the Northwest Plains. The chronology established by Mulloy (1958) and modified by Frison (1978) divides the prehistory of the area into six general cultural periods (Table R2-14).

The development of coal resources has stimulated most of the surveys in the region. Coal related surveys in the region include: Medicine Bow Coal Company by Zeimens (1973); Seminoe I, Seminoe II, and Cherokee Mines by Walker and Zeimens (1976); Seminoe I, Seminoe II, and Hanna South Mines by Larson and Walker (1977); Rosebud Coal Mine by Larson and Craig (1977); Energy Development Mine by Walker, Todd, and Zeimens (1977); and a sample survey of the entire southcentral coal ES area by Metcalf (1977). Two other major surveys in the area have been conducted in connection with the proposed Savery-Pot Hook reservoir; Jennings and Daniels (1976), and Baker (1976).

As a result of these surveys, over 144,200 acres of the 5.5 million acre ES area have been intensively inventoried with over 800 archeological sites having been recorded.

Intensive cultural resource inventories for the three pending projects (Seminoe I, Cherokee, and Hanna South) recorded 78 prehistoric sites and no historic sites. During the evaluation of these sites, it was determined that all available cultural data has been recovered from 60 sites. The remaining 18 sites require further testing to establish their significance. During these inventories and evaluations, the State Historic Preservation Officer has been consulted.

The Union Pacific Mammoth kill site, about 40 miles southwest of Rawlins, has been dated at 11,280 plus or minus 350 years before present (B.P.). It consists of the semi-articulated remains of a mammoth and several associated artifacts. Isolated Folsom points have been found in the region and several Paleo-Indian components are known to exist in regional sites. These data suggest that significant numbers of these important Paleo-Indian sites are present in the southcentral coal region.

The Early Plains Archaic or Altithermal period, from 7500 B.P. to 5000 B.P., is generally thought to represent a cultural gap in the region. Metcalf (1975) suggests there may have been marginal occupation of the region during this period of elevated temperature and intensive drought. McKean points are known from amateur collections and may reflect occupation of the region during the Altithermal; if so, this information is of considerable importance to the regional archeological record.

Middle period sites, from 4500 B.P. to 2000 B.P., are fairly abundant in the region. Metcalf (1977) reported six Early Middle period sites. The Scoggin site, a bison kill with associated McKean complex points dating 4540 plus or minus 110 years B.P., and a McKean lithic scatter are also within the region.

Twenty-six Late Middle period sites were reported by Metcalf (1977). The Garrett Allen Site, listed on the National Register of Historic Places, contains an occupational level dating from this period.

Within the region, twenty Late Period sites have been identified. Most of these are campsites, with associated ground stone. Only one site has associated pottery, and another has associated petroglyphs.

Throughout the historic period, the principal group present within the ES area was the Shoshone, although Commanche, Flathead, Crow, Arapahoe, Gros Ventre, Cheyenne, and Sioux are known to have encroached on this territory for raiding, hunting, or trading.

The Garrett-Allen site has a Historic Period component. No other sites of the Historic Period have been specifically identified within the ES region.

Love (1976) suggests, on the basis of regional surveys, that sites are located in three principal areas—dunes, springs, and playa lakes. He further suggests that dune sites were probably wintering areas since winters would be relatively milder in them. Springs and playa lakes would reflect intermittent spring, summer, and fall occupations, depending on the seasonal availability of food resources.

Basic site types in the region include stone circles slab-lined fire pits with nearby suggestions of huts constructed of branches, firepits without associated structures, flake scatters, quarries, communal animal kill sites, village and camp sites, and petroglyphs.

Presently, The Garrett Allen Prehistoric site in the Elk Mountain vicinity is the only archeological site in the region on the National Register of Historic Places (Federal Register, Vol. 41, No. 21, Tuesday, February 1, 1977).

Historical

Although the history of the southcentral ES area is a series of complex interrelationships, the types of historical sites may generally be divided into five broad categories; Fur Trade and Early Exploration, Transportation,

Table R2-14

CULTURAL CHRONOLOGY OF THE ES AREA

Period	Date B.P. (Before Present)	Projectile Point Style or Cultural Group
Historic	(300 B.P. to Present)	Shoshonean Cheyenne Gros Ventre Commanche Flathead Crow Arapahoe
Late Prehistoric	(1,750 B.P.-300 B.P.)	Shoshonean Intermountain
Late Plains Archaic	(3,000 B.P.-1,700 B.P.)	
Middle Plains Archaic	(5,000 B.P.-3,000 B.P.)	Scoggin Duncan Hanna McKean
(Altithermal)	(7,500 B.P.-5,000 B.P.)	McKean (?)
Paleo-Indian	(11,200 B.P.-7,500 B.P.)	Lusk Federick Cody Alberta Hell Gap Agate Basin Midland Folsom Clovis

Military Operations, Minerals Development, and Ranching.

Fur Trade and Early Exploration

Within the ES area, there is little evidence remaining of the fur trapping days. One reported location of the Bridger-Fraeb Trading Post lies within the area. The present location of Arlington was also the site of several trading posts. The site of a battle between trappers and Indians may be located with the area, reportedly lying near Battle Mountain. The location and extent of existing ruins for these sites is presently unknown.

Transportation

The Overland Trail was the major travel route through the ES area until the coming of the UPRR in 1868. The trail exists today in varying states of preservation, ranging from areas where the trail has been obliterated by contemporary roads, to areas of original wagon wheel ruts.

Within the ES area, eleven stage stations were built along the Overland Trail (see Table R2-15 for a listing of the sites and description of the existing ruins).

Construction of the Union Pacific Railroad within the area began in the spring of 1868. Historical sites associated with the railroad include many abandoned station sites (see Table R2-16), as well as the present city of Rawlins.

The new role of stage lines in the area became that of "feeder lines"for the railroad. The Rawlins—Fort Washakie Stage Route was one such feeder line which ran northwest from Rawlins. The trail served as a main transportation route from 1887 to 1906. "In several areas, original trail ruts are still visible, while at other locations on the trail the ruts are visible but have been taken over as access roads for current usage, destroying many of the original features" (BLM 1976c). The remains of four stage stations are associated with the Rawlins—Fort Washakie Stage route (see Table R2-17).

Another feeder line within the area was the Walcott to Encampment line, with an associated station site, the Midway Station, which is currently a nomination to the National Register of Historic Places.

A third feeder line ran from Rawlins to Baggs during the 1870s, but most of the trail has been obliterated by existing roads.

Military Operations

Two forts which were used as a basis for military operation exist within the area. Both are on the National Register of Historic Places.

Fort Halleck. Fort Halleck was built by Lt. Col. William A. Collins in 1862 in an effort to help protect the Pacific Telegraph Line and Overland Stage Stations from Indian raids. This was an important Indian war military post from 1862 until 1866, when it was abandoned by the military and was salvaged for the building of Fort Sanders near the Big Laramie River. One of the structures from this site exists on private land.

Fort Fred Steele. Fort Steele was built in 1868 as a base for military operations during the Indian wars. Its original function was for the protection of survey and construction crews of the Union Pacific Railroad and the transcontinental telegraph line. The fort was abandoned by the military in 1886.
Ruins of the fort include part of the old quartermaster's corral, a stone ordinance magazine, and the remains of several wood frame buildings including the house of Fenimore Chatterton, acting Governor of Wyoming from 1903 to 1905. The officer's barracks were destroyed by fire in 1970, and two enlisted men's barracks were destroyed by a fire on New Year's Eve, 1976. A graveyard, which lies on land that has recently been donated to the state, also exists at the site.

Minerals Development

Historically, minerals development within the ES area has concentrated on coal, copper, and oil and gas.

The primary stimulus to coal mining on a large scale in the area was the demand for coal as locomotive fuel on the railroad. (Historical sites associated with early coal mining in the area are listed in Table R2-18.)

Copper mining in this area was mainly associated with the Grand Encampment Mining Region which was most active from about 1896 to 1906. Five historical sites are associated with this mining region (see Table R2-18).

Sites related to the history of oil and gas development within the ES area are listed in Table R2-18.

Ranching

Ranching in the region developed from a small-scale trading of fresh stock for trail-worn stock along the Overland Trail, to a large-scale cattle and sheep market. The construction of the railroad allowed the cattle and sheep to be shipped to other parts of the country. (Sites connected with early ranching in the area are listed in Table R2-19.)

VISUAL RESOURCES

The southcentral Wyoming Coal ES region is composed of a variety of basic landscapes; rolling sage plains, badlands, river bottoms, lakes, foothills, forested mountains, sand dunes, deserts, and altered landscapes, (i.e., farmland, ranches, mineral extraction areas, urban centers, etc.).

The landscapes have been classified under the Visual Resouce Inventory and Evaluation System (BLM Manual 6310, currently under revision). The analysis from which these classes have been taken is available at the Rawlins District Office of the BLM. Classes are delineated on the Visual Resource Management Classes Map (Map 10, Appendix A). The region is represented by all five Visual Resource Management (VRM) classes.

Table R2-15

REGIONAL STAGE STATIONS

Site	National Register Site	Nomination to National Register	Nomination in Process	Description of Site
Rock Creek Station				
Elk Mountain (Medicine Bow Station)				Elk Mountain Trading Co. Store was later built on this site. Log ruins remain.
Elk Mountain (Fort Halleck Station)				Historical Marker and stone ruins.
Pass Creek Station				No physical remains have yet been located.
Platte River Crossing	X			Eight-grave cemetery and nearby cliff face with the signatures of many Overland Trail travelers.
Sage Creek Station		X		Stone markers and graves.
Pine Grove Station		X		Foundation remains graves, stone ruins and an Historical marker.
Bridger's Pass	X			Remains of wooden buildings, a watering area and visible wagon wheel ruts.
Sulphur Springs Station			X	Historical marker, graves, two stone buildings, a dugout and tunnel, ranch buildings and bridge ruins.
Washakie Station		X		Stone ruins, well ruins, and ruts having been disturbed by vehicles.
Duck Lake Station		X		Stone bridge, stone remnants of a building, a stone well and visible wagon wheel ruts.

Table R2-16

HISTORICAL RAILROAD SITES

Site	National Register Site	Nomination to National Register	Nomination In Process	Description of Site
Benton				Site of "tent town" for construction workers on railroad. Remains: an original 20-mile post, the the roadbed of the Y-spur and an old fence.
Percy				Condition of site presently unknown.
Old Latham				Condition of site presently unknown.
Separation Station				Condition of site presently unknown.
Walcott				Site was the busiest loading point for the railroad between Omaha, Nebraska and Ogden, Utah. Remains: an old saloon and several cabins.
Timber Town				Site was location of tie cutting and loading facilities. Remains: houses, general store, well, saw mill, and loadout facilities.

Table R2-17

RAWLINS--FORT WASHAKIE STAGE ROUTE

Site	National Register Site	Nomination to National Register	Nomination In Process	Description of Site
Bell Springs Stage Station				Stone foundation and scattered stone ruins.
Cherokee Springs Stage Stagion				Presently an occupied ranch.
Seven Mile Meadows Stage Station				Presently an occupied ranch.
Separation Station				Stone foundation of a house, well, and scattered stone ruins.

Table R2-18

HISTORICAL SITES OF MINERALS DEVELOPMENT

Site	National Register Site	Nomination to National Register	Nomination In Process	Description of Site
COAL				
Carbon			X	Numerous stone foundations and a large cemetery
Hanna				An existing mining town
Dana				Condition of site presently unknown
Cherokee				Condition of site presently unknown
Sampo				Condition of site presently unknown
Ream & Ramsey Coal Mine & Searight Mine				Condition of site presently unknown
COPPER				
Ferris-Hagarty Mine Site	X			
Boston-Wyoming Smelter Site	X			Foundation ruins of the only smelter supportive to the Grand Encampment Copper Boom.
Dillon (town site)				
Elwood (town site)				
Rambler (town site)				
OIL				
Sinclair (PARCO)				Model Company Town built in Spanish Colonial style. Refinery is still operating and expanding.
McFadden				Condition of site is presently unknown
Kyle				Condition of site is presently unknown
Hatfield Camp				Condition of site is presenlty unknown

Table R2-19

HISTORICAL RANCHING SITES

Site	National Register Site	Nomination to National Register	Nomination In Site Process	Description of Site
Baker's Cabin	X			Original 3-story log house now in school yard at Savery.
L-7 Ranch System				Extensive system of ranches in the area, most of which are still in use.
Hadsell Ranch				Existing structures still in use.
Fillmore Ranch				Existing structures still in use.
A.A. Anderson Ranch				
Bengough Ranch				Precise location is unknown.
Cecil Ryan Cabin				
Connor Ranch				
Elk Mountain				Current town site.
March & Cooper Ranch				
Swan				
Pine Grove Ranch				

Visual Resource Management Classes

The visual resource management classes are used as tentative minimum management objectives for the visual management units identified. Each visual resource management class describes a different degree of modification allowed in basic elements of the landscape. The primary character of the landscape should be retained regardless of the degree of modification.

Class I

This class provides primarily for natural ecological changes only. It is applied to Wilderness areas (Savage Run), primitive areas, some natural areas, and other similar situations where management activities are to be restricted (see Figure R2-16).

Class II

Changes in any of the basic elements (form, line, color, or texture) caused by a management activity should not be evident in the characteristic landscape. A river bottom composed of dense stands of cottonwood and willow trees with a variety of seasonal color is one example of VRM Class II area. Other examples are badlands (Adobe Town area), unique sand dunes, foothills, and some high use areas (see Figure R2-17).

Class III

Changes in the basic elements, (form, line, color, texture) caused by management activity may be evident in the characteristic landscape. However, the changes should remain subordinate to the visual strength of the existing character. Examples of VRM Class III areas include areas along major roads where use volume is high (see Figure R2-18).

Class IV

Changes may subordinate the original composition and character, but must reflect what could be a natural occurrence within the characteristic landscape. The Class IV usually offers little variety in visual character. The areas are generally confined to high plains and deserts. However, the areas do provide various combinations of color in vegetation and soil due to changes in weather and season (see Figure R2-19).

Class V

Change is needed. This class applies to areas where the naturalistic character has been disturbed to a point where rehabilitation is needed to bring it back into character with the surrounding countryside. This class would apply to areas identified in the scenery evaluation where the quality class has been reduced because of unacceptable intrusions. It should be considered an interim short-term classification until one of the other objectives can be reached through rehabilitation or enhancement. Altered landscapes best describe Class V areas. These could include areas such as strip mining projects, towns and cities, and areas that have been severely overgrazed (see Figure R2-20).

RECREATION RESOURCES

Visitor Use Data

Table R2-20 shows estimated resident visitor use by activity for the region based on an estimated 1977 population of 18,484. The data used to derive these estimates are available at the Rawlins District Office of the BLM.

Hunting

The region with its mountain ranges, hills, plateaus, and prairies provides some of the best variety of hunting in Wyoming. The big game hunting resource has national significance. In 1977 nearly 23% of the hunters in the region were nonresidents (Wyoming Game and Fish Department).

Mule deer, elk, and antelope are the most plentiful and sought after big game in the region. These animals can be hunted within a short distance of most area communities. Deer hunting attracts the greatest number of hunters, but elk accounts for the largest number of hunter days (see Fish and Wildlife).

The principal upland and small game species hunted in southcentral Wyoming are sage grouse, blue grouse, and cottontail rabbit. The number of upland game hunters varies according to location, primarily because of the availability of public access to private lands where these species are frequently found.

Waterfowl hunting totals less than 1% of the region's recreation days. Larger streams such as the North Platte, Medicine Bow, and Little Snake Rivers provide the best hunting in season; however, there is considerable hunting of waterfowl on beaver ponds scattered throughout the region.

While other types of nongame hunting activities do take place, the total of hunters and recreation days were not known.

Fishing

Fishing is largely centered around Seminoe Reservoir, Medicine Bow National Forest lakes, the Little Snake River, the North Platte River, and in beaver ponds and smaller streams. These areas contain more fishing opportunities than any others in the region and have the greatest present, as well as potential, use.

Based on a University of Wyoming study, approximately 42% of those people questioned in the region par-

Figure R2-16

VISUAL CLASS I--SNOWY RANGE SCENIC AREA

Figure R2-17

VISUAL CLASS II--FOOTHILLS

Figure R2-18

VISUAL CLASS III--HIGH USE AREA

Figure R2-19

VISUAL CLASS IV--HIGH DESERT

Figure R2-20

VISUAL CLASS V--RAILROAD SPUR

Table R2-20

1977 ESTIMATED RESIDENT VISITOR USE
IN THE SOUTHCENTRAL WYOMING REGION BASED
ON AN ESTIMATED POPULATION OF 18,484

Activity	Visitor Days*
Fishing	76,893
General**	98,705
Hunting (Big Game)	28,476
Off-Road Vehicle	2,957
Urban	46,949
Water Sports	35,489
Winter Sports	9,427

* Visitor Day consists of 12 hours.
** General includes camping, picnicking, sightseeing, etc.

ticipated in some form of sport fishing in 1976. The opportunity to combine fishing with other recreation such as boating (see Figure R2-21) and picnicking undoubtedly accounts for some of this use.

General Recreation

Interstate 80 is a major route for recreationists traveling east and west (see Figure R2-22). U.S. Highway 287 is a major route toward Yellowstone and Teton National Parks. The biggest attractions along these routes are the numerous opportunities to view antelope, deer, eagles, hawks, and occasionally elk and wild horses.

The portion of the Medicine Bow National Forest within the ES region is considered most scenic and accounted for approximately 250,000 visitor days in 1977. The forest is an excellent example of a unique ecosystem adjacent to prairie lands. Wildflowers and autumn and spring foliage are always of interest in season. The prairie has interesting forms of vegetation native to the area that can be seen at practically any location.

Mountain areas provide sightseeing opportunities during the summer along off-highway truck trails and footpaths. Open areas in the timber provide more chance of viewing big game, birds, predators, and other wildlife.

The U.S. Fish and Wildlife Service has fish hatchery facilities near Saratoga that provide opportunities to view fish management programs.

Interstate 80, U.S. Highways 287 and 30, and State Highways 789, 487, 230, 130, 72, 71, and 70, along with various county roads (improved and unimproved), provide excellent wildlife viewing for the traveler.

Plant collecting is dispersed throughout the region, and appears to be done in conjunction with other recreational activities.

Gem and/or mineral collecting is somewhat popular in the region; jade and petrified wood appear to be most popular. This collecting also appears to be done in conjunction with other recreational activities. Approximately 1% of the population participate in rock-hounding on a regular basis (University of Wyoming).

The most notable geological resources of recreational value are found on the Atlantic Rim, Delaney Rim, Red Desert, Baggot Rocks, Adobe Town, Tortilla Agate sites, and around major stream formations.

Archeological collecting on public land is not legal under the Federal Antiquities Act; yet the activity is known to take place. Figures are not available to quantify this "pothunting". Arrowheads and other artifacts are found on both public and private land.

Various sites provide good opportunities for understanding and appreciating the region's rich history. These include the Overland Trail and other sites of pioneer and Indian activity. There is no quantitative information available as to the total recreation days spent in these pursuits.

Camping is a very popular activity which occurs primarily during the summer season. Approximately 51% of the population owns some type of camping equipment (University of Wyoming). Thus, this activity ranks as one of the most popular summer pastimes. Camping activities usually are accompanied by other activities such as rock hounding, hiking, fishing, or boating. Insufficient data exist to support a statistical relationship between any of these activities.

Except for municipal facilities, recreation developments within the region are minimal. Seminoe State Park, located on Seminoe Reservoir (25 miles from Rawlins) is used during the day for camping and water related recreation. The Medicine Bow National Forest (55 miles from Rawlins) has similar, but extensive use. Two areas exist on public lands for camping--the Bennett Peak area and the Corral Creek area. Most camping and picnicking is confined to the cooler mountain areas of the national forests.

Off-Road Vehicles

Four-wheel drive vehicles and off-road motorcycles are closely associated with camping and/or hunting activities (see Figure R2-23). Their use on public lands is considerable. Most recreationists do not perceive the four-wheel drive units as a source of recreation, but use them as a means of transportation to achieve individual pursuits. Over 36% of the region's population owns at least one four-wheel drive unit (University of Wyoming).

Urban Recreation

Municipal parks and playgrounds in Carbon County totaled 141 acres in 1972 (Wyoming Recreation Commission 1975).

Rawlins' recreation is focused on several small parks. The largest city park in Rawlins (Washington Park) offers lighted horseshoe pits, picnic facilities, tennis courts, volleyball, outdoor swimming pool, and a basketball court. In December 1976, Rawlins and BLM agreed to develop 50 acres west of Rawlins as an addition to the city parks. Four ballfields are currently under construction at this park, and four others are under construction at the V.F.W. park. There is also a pool at the high school for public use. Four municipal tennis courts are available. There are also two miniature golf courses, a bowling alley, and a roller rink. For regulation play, Rawlins golfers go to Sinclair or Saratoga.

The Jeffrey Memorial Center is a unique facility for a town the size of Rawlins. This building serves as a community center and convention hall. It is able to accommodate meetings up to 1,000 persons. The center has two floors, 10,000 square feet each. The basement floor can be used for athletic activities including archery, rifle and pistol shooting, and boxing (Bickert, Brown, Coddington 1976).

Generally, the urban facilities, parks, and playgrounds, in the region are not of sufficient size to accommodate the existing general public. Recreation programs are basically limited to summer months. The summer programs are small because of a limited budget for recreation and

Figure R2-21

FLOAT BOATING ON THE NORTH PLATTE RIVER

Figure R2-22

ELK MOUNTAIN--A LANDMARK FOR PIONEERS USING THE OVERLAND TRAIL

Figure R2-23

OFF-ROAD VEHICLES ON PUBLIC LAND NEAR RAWLINS

park purposes. Most activities during a given year are conducted by private groups and individuals.

Winter Activities

Downhill skiing close to the region is restricted to two areas, Medicine Bow Ski Area on the eastern slope of the Snowy Range of the Medicine Bow National Forest, and Fox Park Ski Area on the western slope of the same range. The latter is readily accessible to the population of the ES region, but services are very limited.

Five percent of the region's population participate in downhill skiing (University of Wyoming). This is in excess of the national average (less than 1%, but well behind the average for adjacent areas of the state (Albany County—34%). Many skiers at the two local areas come from Colorado, but the total numbers are small due to accessibility to ski areas in their own state.

Cross-country skiing is not participated in to any real degree (approximately 3%). Sledding and ice fishing are somewhat popular among the region's population; approximately 6% participate.

Significant regional participation in outdoor recreation activities during the winter months does occur with snowmobiling activities. More than a third of the population (38%) actively participate. The primary area for snowmobiling is located in the Medicine Bow National Forest; however, if sufficient snow is available this activity is pursued throughout the area (see Figure R2-24).

Water Activities

Seminoe Reservoir is the primary regional area for water based activities. Another major area used is North Platte River between Saratoga and the Colorado border, principally for fishing, and float boating. Swimming and waterskiing are of moderate interest to regional residents with 7% participating.

Wilderness Areas, and Potential Wilderness Study Areas, and Potential Wild and Scenic Rivers

The Forest Service has conducted a roadless inventory (RARE II) in compliance with the Wilderness Act of 1964. These areas are shown on Map 11, Appendix A. The BLM is now in the process of finalizing wilderness inventory procedures in response to Section 603 of the Federal Land Policy and Management Act of 1976. The closest roadless area is in Medicine Bow National Forest, approximately 15 air miles from any known coal area. The Savage Run area has been designated as a wilderness area.

Two rivers that have Wild and Scenic potential are the southern portion of the North Platte in Wyoming, and the southern portion of Encampment River also in Wyoming; both are shown on the regional map.

AGRICULTURE

Livestock Grazing

Production of range beef cattle and sheep is the predominant land use within the ES region. An estimated 96% of the land is grazed by livestock. On the basis of the 1974 census of agriculture, an estimated 250 farms are located within the ES region. The farm or ranch size is quite variable—22% of the farms are under 500 acres in size; 10% are 500 to 1,000 acres; 10% are 1,000 to 2,000 acres; and 58% are over 2,000 acres. Livestock operations vary in a similar proportion. They range from a low of approximately 50 animal units (one cow and calf or five mature sheep equal one animal unit) upward to over 1,000 animal units.

The number of livestock in the region during any one year is dependent upon market and/or forage conditions. For the past decade, livestock operations have been shifting from sheep to cattle, owing to unfavorable economic and management situations. During the period of 1969 thru 1974, cattle numbers have increased approximately 24% while sheep numbers have decreased 34%. Field observations indicate that this trend is continuing. The major classes of livestock are cattle, domestic sheep, and horses. According to the Abstract of Assessment Roll on Personal Property, there are 91,471 cattle; 71,507 sheep; and 1,603 domestic horses on area ranches.

Over 95% of the ranch operations rely on leased lands to maintain size of operations at desirable economic level. Public and state lands are the major component of leased lands.

Within the ES region, land ownership is distributed as follows: private, 42%; public lands, 42%; national forest lands, 12%; and state lands, 4%. The proposed project areas comprise less than 1% of the regional area. Most public lands are under BLM grazing management and are allocated to ranch units. Public lands contained within the three proposed project areas are in a checkerboard ownership pattern and are used in conjunction with adjoining private or state lands.

Grazing use may either be seasonal or yearlong, depending on the management system established on the specific tract. Sheep operations rely on native range to winter the livestock. During severe winters, they supplement feed with native hay and/or purchased protein concentrates. Cattle are generally wintered near ranch headquarters, and are maintained on locally grown hay as well as protein supplements. During the summer months, livestock is moved to summer rangelands, which for many bands of sheep are the mountain ranges. Sheep are trailed or trucked varying distances to grazing allotments on the national forests. Cattle utilize lower elevation range allotments on the national forest as well as ranges on public land during the summer months.

Figure R2-24

SNOWMOBILERS IN MEDICINE BOW NATIONAL FOREST

The area included in the three site specific coal projects areas under evaluation in the ES region involves five range allotments. Five ranch operations graze livestock on these allotments during the year.

Livestock distribution and use of available range forage is affected by water availability. Livestock water impoundments are important since little natural water exists in many parts of the ES region. Streams are limited and most are intermittent. Control of livestock on the range allotments is done primarily by fencing for cattle and the utilization of both herding and fencing for sheep. Other facilities necessary for livestock management on the ranges include corrals, stock driveways, access roads, and ranch facilities.

Farming

Hay and forage are the major crops in the region and are produced for livestock industry needs. Most farming is conducted by livestock operations. Hay is utilized locally to provide yearlong feed requirements. Small grain production is conducted mainly on dryland farms in the Saratoga Valley by the summer fallow method. An estimated 4,100 acres of wheat is grown annually as a cash crop. Other small grains grown include limited acreages of oats and barley which are utilized as supplemental feeds. Alfalfa hay is produced on approximately 17,000 acres, and native hay on the remaining 80,000 acres of the 97,000 acres of hayland in the ES region.

Hay production is confined to bottom lands along major streams in the region. A large majority of the hayland is surface irrigated and total production is limited by water supply. Some meadows harvested for hay are not surface irrigated, but are subirrigated by natural means. Hay production by dryland farming methods is very limited and the production is low. Evidence indicates that attempts were made in the past at dryland farming, but the areas have since been returned to grazing land or abandoned. There is no cropland within the project areas of the mining proposals.

FOREST RESOURCES

The timber resource is confined primarily to the mountainous area of the ES region. Timber stands of commercial quality and extent which are economically manageable are located at or above the 7,800 foot elevation. The primary forest types harvested are the lodgepole pine, type 63; and spruce-fir, type 64.

The sawtimber stands of the ES region and adjoining areas are the primary source of raw materials for the commercial lumber mills in Saratoga, Walden, and Laramie. The primary market for the products of these mills is located outside the state of Wyoming. Convertible products (posts and poles) are harvested by the local ranch operators and two commercial processors located in or adjacent to the region. The dead material (aspen and pine) is utilized to a limited degree for firewood by local residents. The proposed coal project areas are all located 5 miles or more from any timber resource area.

MINERAL RESOURCES

Coal

Coal resources of the ES area are contained in two regions--the Green River Coal Region and the Hanna Coal Field (see Map 3 in Appendix A). Table R2-21 presents typical analyses of regional coal.

Green River Coal Region

The Green River Coal Region covers about 15,400 square miles of southwestern Wyoming. It includes part of the southcentral ES region. It is divided into two major structural basins by the Rock Springs anticline: the Green River Basin to the west and the Great Divide Basin to the east. Dips in this region are small except around the Rock Springs Uplift and the eastern margin. Dips on the western side of the Rock Springs Uplift are up to 20 degrees; on the eastern side to 10 degrees. Along the eastern margin of the region, dips range between 20 degrees and 60 degrees in some areas.

Coal ranges in rank from subbituminous C to high volatile C bituminous. The higher rank coals occur on the eastern margins of the region as well as around the Rock Springs Uplift. The higher rank coals are of Cretaceous age.

Coal-bearing rocks in the Green River Region are largely concealed by younger rocks and very little is known about the total coal resources in the area. Coal beds in the region occur in the Mesaverde Group and the Lance Formation of Upper Cretaceous age, the Fort Union Formation of Paleocene age, and the Wasatch Formation of Eocene age (Glass 1976).

The Mesaverde Formation coals range from subbituminous to high volatile C bituminous. The coals have not been extensively mined, but average up to 12 feet thick (Glass 1976).

Lance Formation coals range from less than 5 feet to as much as 22 feet thick. They average 9,780 British thermal units (Btu) per pound, 5.5% ash, 20.8% moisture, and 0.77% sulfur (Glass 1976).

Although Fort Union Formation coals are some of the thicker and more persistent coals in the region, they were not extensively mined until 1974 when the Jim Bridger strip mine near Rock Springs, Wyoming opened. Up to 30 feet of coal is exposed in that area. South of the Bridger Mine, Fort Union Formation coals average 10 to 26 feet thick in the Black Buttes area. In both cases the coal is subbituminous in rank. The Bridger Mine and the Black Buttes area are addressed in the Southwestern Wyoming Regional Coal ES.

Wasatch coals in the southern part of the Great Divide Basin Field are designated from youngest to oldest: Battle No. 3, Battle No. 2, Monument No. 1,

Table R2-21

TYPICAL ANALYSES OF REGIONAL COAL

Bed--As received basis	Moisture (%)	Volatile Matter (%)	Fixed Carbon (%)	Ash (%)	Sulfur (%)	Btu/lb
B and C	15-20	28-36	27-40	10-25	0.5-5.0	5,009-9,000
Battle #3	21.9	29.9	37.0	11.2	1.9	8,650
Creston #2	20.7	32.2	34.4	12.7	1.8	8,710
Other Creston	23.0	31.0	32.2	13.8	2.7	8,250
Latham #3	22.6	30.9	31.2	15.3	5.4	7,980
Sourdough #2	23.2	33.6	33.0	10.2	2.9	8,860
Bed 24	14.0-16.0	34.3	45.8	0.4-3.9	0.3-0.4	10,050-10,180
Bed 25	14.6	33.6	42.0	9.8	0.5	9,327
Bed 50	11.3-14.3	34.1	43.7	10.9-13.6	0.4-0.43	9,410-10,070
Bed 65	9.6	37.6	47.7	5.7	0.65	11,213
Bed 80	11.5	38.3	43.6	6.6	0.9	10,665
Bed 82	11.2-13.5	40.9	40.6	6.9-10.7	0.73-1.0	10,140-10,870
Brooks Bed	10.6	35.1	47.1	6.9	0.55	10,935
Hanna No. 1	10.6	36.9	37.9	14.7	0.47	9,831
Hanna No. 2	10.2	39.6	44.4	5.8	0.37	11.350

Sourdough Monument-Tierney coals, Hadsell No. 2, Creston No. 3, Creston No. 2, and Latham No. 3. These coal beds are lenticular and grade into shale to the east and west. Analysis of these coals shows averages of 21% moisture content, 16% ash content, 2.5% sulfur content, and a heat value of 7,900 Btu/lb. Additionally the uranium content of these coals may range between 0.001% and 0.009% U_{308}. These Wasatch coals are estimated to contain over 55 million pounds of uranium with U_{308} content of 0.003% or greater. The following Wasatch coals are found in the region.

B and C Coal Beds. These two unmined coals are subbituminous A coals of the Wasatch Formation and reach their maximum development in the northern part of the Little Snake Field. The B coal ranges from 10 to 18 feet thick and normally has a 1 to 2 foot parting in it. The C bed, which is 40 to 70 feet below the B bed, ranges in thickness between 20 and 32 feet. It has a 1 to 1½ foot parting. In places these two beds coalesce into a single coal 30 to 40 feet thick, which has a parting up to 4 feet thick. Strippable reserves collectively reach 200.9 million tons.

Battle No. 2 and Battle No. 3 Coal Beds. These two subbituminous B coals crop out in the southeastern part of the Great Divide Basin Field. They are coals of the Wasatch Formation, and average between 6.4 and 8.6 feet in thickness. Strippable reserves are estimated at 38.1 million tons.

Creston No. 2 and Creston No. 3 Coal Beds. These coals are in the Wasatch Formation in the Great Divide Basin Field. They crop out in the southeastern part of the field where they average about 18 feet thick. They are subbituminous B in rank. Strippable reserves are estimated at 125.6 million tons.

There is another Wasatch coal cropping out in the southeastern part of the Great Divide Basin Field. It is subbituminous B in rank and averages 7.7 feet thick. There are 39.8 million tons of strippable reserves estimated for this coal.

Latham No. 3 and Latham No. 4 Coal Beds. The Latham coals are best developed in the southeastern part of the Great Divide Basin Field. They occur in the Wasatch Formation and are subbituminous B coals. Average thickness is 5.7 feet. Strippable reserves total 70.7 million tons.

Sourdough—Monument—Tierney Coal Beds. This group of coals is actually five beds that occur at about the same horizon in the Wasatch Formation in the southeastern part of the Great Divide Basin Field. Because these coals at times coalesce with one another, separation of the coals into individual beds is not always possible. In places, each of these subbituminous B coals exceeds 5 feet in thickness. Strippable reserves are 458.9 million tons.

Hanna Field

Coal-bearing rocks of the Hanna Field crop out in a 750 square mile area of Carbon County in southcentral Wyoming. Most simply, the Hanna Field occupies a structural trough that is divided into two separate basins by a northeast-southwest trending anticline. The Hanna Basin lies to the northwest of the anticline while the Carbon Basin lies to the southeast. The Hanna Field is bounded on the north, west and south by mountain ranges. Faulting is common in the field.

Coals occur in the Mesaverde Group and Medicine Bow Formations of Upper Cretaceous age, the Ferris Formation of Upper Cretaceous and Paleocene age, and the Hanna Formation of Paleocene and Eocene age. The rank of the coals in the Hanna Field ranges from subbituminous C to high volatile C bituminous. The highest ranked coal, high volatile C bituminous, occurs in the Mesaverde Group. Collectively, coals of this group and the Medicine Bow Formation range downward in rank to subituminous B. The Hanna Formation and Ferris Formation coals are predominantly subbituminous although the Hanna No. 2 bed of the Hanna Formation has reportedly been ranked as high volatile C bituminous.

Total strippable reserves in the Hanna Field are approximately 313 million tons. The following coals are important in the Hanna Field.

Bed No. 24. This subbituminous Ferris Formation coal averages 18 to 20 feet thick. Arch Mineral presently strip mines it on the west side of the Hanna Field in their Seminoe I Mine.

Bed No. 25. Bed No. 25 is a subbituminous coal in the lower third of the Ferris Formation and is best developed on the west side of the Hanna Field. This coal averages up to 22 feet thick except where it splits into as many as three thinner benches, designated 1, 2, and 3 from the top down. Bench 1 averages 4 feet thick; Bench 2 averages 5.5 feet; Bench 3, or the lower bench, averages 7.7 feet thick. The coal is currently mined in Arch Mineral's Seminoe I Mine.

Bed No. 50. This coal occurs near the middle of the Ferris Formation and is of subbituminous rank. The bed is best developed west of the town of Hanna where it is presently mined in Energy Development's Vanguard No. 2 deep mine. It varies between 15 and 19 feet thick.

Bed No. 65. This Ferris Formation coal is of Paleocene age. It is subbituminous in rank and is now mined in Energy Development's Vanguard No. 3 deep mine. The coal is important west of the town of Hanna where it ranges from 6 to 8 feet thick.

Bed No. 80. Bed No. 80 is a Paleocene coal of the Hanna Formation. The rank is subbituminous. This coal is well developed in the Hanna Basin where it ranges from 15.5 to 24 feet thick. The No. 80 bed generally has a 1 to 1½ foot parting 2 to 5 feet above the base. It is presently mined at Rosebud Coal Sales strip mine north of Hanna.

Bed No. 82. This coal bed is an Eocene coal in the Hanna Formation. It is a subbituminous coal averaging 9 feet thick and is best developed in the Hanna Basin. It is strip mined north of Hanna by Rosebud Coal Sales Company.

Brooks Coal Bed. This coal is a subbituminous Paleocene coal near the base of the Hanna Formation. It ranges between 7.5 feet and 15 feet in thickness and is mined in Resources Exploration's Rimrock strip pits in Carbon County.

Hanna No. 1 Coal Bed. Although this Hanna Formation coal is not now mined, it has been extensively deep mined in the past. The coal ranges between 15 and 30 feet in thickness and is presently being converted into a low Btu gas at an Energy Research and Development Administration (ERDA) in situ gasification site south of Hanna. The coal is subbituminous in rank.

Hanna No. 2 Coal Bed. This coal is normally of subbituminous A rank, but in places it is ranked as high volatile C bituminous. It was extensively deep mined in the past and Arch Mineral presently strip mines it in their Seminoe II mine near Hanna, Wyoming. The Hanna No. 2 coal ranges between 30 and 36 feet thick.

The estimate of remaining coal resources of Wyoming to January 1, 1975, is shown in Table R2-22. The remaining strippable subbituminous coal reserves of the Green River Coal Region and the Hanna Coal Field to January 1, 1975, are shown in Table R2-23. Present production is about 10.9 million tons per year. Nearly all of the coal is shipped by rail to the Midwest for power generation.

Uranium

Tertiary sedimentary rocks, especially the Brown's Park and Wasatch Formations, appear to be the host rocks for the majority of the uranium deposits found in Wyoming. Rocks containing uranium include tuffaceous sandstones and mudstones, and coal-bearing carbonaceous rocks, nearly all of which were deposited in continental or marginal marine environments. Most of the productive deposits are in continental fluvial sandstone and may be epigenetic (of later origin) with respect to the enclosing rocks for these reasons; (1) lateral margins of deposits that cut across sedimentary structures of the enclosing rocks, (2) uranium and other metallic minerals partly filling interstices between grains of the rock, (3) partial replacement of plant remains, and (4) sparse partial replacement of rock minerals by ore minerals.

Vanadium and selenium minerals generally occur in the uranium deposits found in Wyoming, but not in sufficient quantities to warrant installation of recovery equipment in the uranium processing mills.

Numerous mining claims have been located for uranium throughout the ES region. Felmont Oil Corporation has located numerous claims in the area between Saratoga and Walcott Junction and in the area north of Dana Ridge in the Dana Basin. An extensive drilling program was conducted by Felmont on many of their claims during the spring and summer of 1976. Results of this drilling activity are not available.

Most of the Red Desert has been blanketed by uranium claims. A majority of these have been staked by Mineral Exploration Company. Union Carbide has done extensive drilling in the Red Desert and has shown a majority of the exploration interest. Mineral Exploration is reported to be opening an extensive mining operation just north of the ES region in the Red Desert.

Renewed interest has also been shown in reopening the mines in the Baggs-Poison Basin area. This is due mainly to the increase in the price of yellowcake (U_{308}) from $5.00 a pound to $30.00 a pound in the last 5 years (BLM 1976c).

Wyoming contains approximately 62,700 tons of U_{308}, 39% of the nation's reserves, and ranks second behind New Mexico in production of U_{308}.

Uranium production in southcentral Wyoming totals 169,000 tons at an average grade of .156%, for a total of 528,876 pounds of U_{308}; 528,760 pounds from the Baggs—Poison Basin area and 116 pounds from Ketchum Buttes (Root 1976). There has been no production in southcentral Wyoming since 1967 (Crew 1969).

Sand and Gravel

Sand and gravel occur along many of the streams and as pediment gravels in southcentral Wyoming. Because of isolation and long distances from population centers, there is little utilization of these deposits. Reserve figures are not available. Dune sands occur in the northwest corner of the ES region and southwest of Rawlins (see Map 12 in Appendix A).

Scoria (Clinker)

Extensive deposits of scoria (clinker) occur along burned coal outcrops. It is widely used for road base and as surfacing material where it is more readily available than sand and gravel. Many deposits have probably not been identified and reserves are unknown (see Map 12 in Appendix A).

Oil and Gas

Production in 1975 in southcentral Wyoming totaled 825,813 barrels of oil and 42,212,072 cubic feet of gas from 243 wells in 40 fields. This is compared with 1,348,192 barrels of oil and 32,273,532 cubic feet of gas from 232 wells in 39 fields in 1974 (BLM 1976c).

AMOCO started an extensive drilling program in 1976 in the western portion of the ES area (BLM 1976c).

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

A large number of separate governmental agencies exercise certain types of land and resource use controls in Carbon County (see Table R2-24). The federal sector includes the Bureau of Land Management (public lands and mineral estate under certain private lands). Development, management, use, and control of use on these public lands has been delegated to this agency.

Table R2-22

ESTIMATE OF REMAINING COAL RESOURCES OF WYOMING TO JANUARY 1, 1975 (MILLIONS OF TONS)

Categories of Original Resources	Mapped and Explored Areas
Original Resources*	136,891.43
Production from strip mining**	113.28
Production from deep mining**	384.48
Total production	497.76
Losses due to strip mining (20% lost)	22.66
Losses due to deep mining (equals production)	384.48
Total production and mining losses	904.90
Remaining resources	135,986.53
Strippable reserve base***	23,825.18
Underground reserve base***	29,490.27
Total reserve base***	53,315.45

*Source: U.S. Geological Survey and U.S. Bureau of Mines

**Source: U.S. Geological Survey, U.S. Bureau of Mines and Wyoming State Inspector of Mines

***Source: U.S. Bureau of Mines

(Modified From Glass 1976)

Table R2-23

REMAINING STRIPPABLE SUBBITUMINOUS COAL RESERVES OF THE GREEN RIVER COAL REGION AND HANNA COAL FIELD TO JANUARY 1, 1975

Coal-Bearing Area	Original Estimated Reserves to January 1, 1968	Production and Mining Losses Since January 1, 1968	Remaining Strippable Reserves to January 1, 1975
Green River Coal Region	1,266,600,000	800,000	1,265,800,000
Hanna Coal Field	313,000,000	39,300,000*	273,700,000

* This is strip mine production and mining losses since 1950.

(Modified from Glass 1976)

Table R2-24

LAND OWNERSHIP

OWNER	LAND (ACRES)
Public Land	2,300,000
U.S. Forest Service	640,000
State	240,000
Private	2,300,000

Table R2-25

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

Jurisdiction	1977 Population	Percent of Carbon County Population
Carbon County	18,137	100.0
Rawlins	10,500	57.9
Sinclair	550	3.0
Hanna/Elmo*	1,500	8.3
Elk Mountain	220	1.2
Medicine Bow	750	4.1
Saratoga	2,050	11.3
Encampment	500	2.8
Baggs Area**	440	2.4
Wamsutter (Sweetwater County)	347	--

* These towns are located several miles apart and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

** This includes Baggs, Dixon and unincorporated Savery with population of perhaps 25.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Institute, Laramie, March 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

Controls are effected through issuance or nonissuance of a variety of leases, permits, licenses, etc. Each authorization to use public lands contains provisions to control that use. Controls exercised by the federal government for the subsurface estate are governed by the statutes authorizing the disposition and use of that estate. Foremost among these statutes is the authority for leasing coal deposits and authority to require, as a condition of such leases, an operation-management plan and a reclamation-restoration plan. Management policy has been extended in greater detail by the National Environmental Policy Act of 1969, and the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. In certain situations, there is a joint or multiagency sharing of particular management and control functions and responsibilities, such as the cooperative agreement between the Department of the Interior and the state of Wyoming that allows the state to administer and enforce reclamation operations on federal leases in Wyoming. The subsurface estate vested in private or state ownership would normally be governed by applicable state of Wyoming statutes.

A number of state agencies have development and administrative authority over state of Wyoming owned lands. Additionally, under state of Wyoming statutes, the state is authorized to perform and administer certain surface land use, planning and development activities on state, county, municipal, and privately-owned properties. Two pieces of legislation passed by the 1975 Wyoming Legislature which could have a significant effect on land use are: The Wyoming State Land Use Planning Act and The Industrial Development Information and Siting Act. The Land Use Planning Act requires completion of county land use plans by 1978, and these plans could conflict with or modify some of the energy proposals. The Industrial Siting Act requires furnishing extensive information and a state permit before certain facilities can be constructed. The impacts of this act would affect developments which include gasification or electric generation proposals. Control does not apply to public properties except as provided by law.

Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands. Certain of these lands were conveyed to the state as part of the Act admitting Wyoming to the Union. This legislation granted Section 16 and 36 of every township to the state for educational purposes. Use and control of these lands (including mineral leasing, rights-of-way, etc.) is governed by Wyoming law.

Under Wyoming statutes, counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes. The authority does not apply to any planning or zoning controls over lands used or occupied for the extraction or production on minerals.

Control over mineral uses is vested in the state of Wyoming under the Wyoming Environmental Quality Act of 1973. This act also authorized the state to control air quality, water quality, and solid waste management.

Where a county or city lacks a specific authority, provisions of the Wyoming Joint Powers Act are available to enable joint exercise of power, privilege, or authority. This legislation enables two or more agencies to jointly plan, create, finance, and operate (control) water, sewage, or solid waste facilities; fire protection agency facilities; transportation systems facilities; and public school facilities.

Carbon County has developed and adopted a comprehensive plan and passed zoning ordinances to control land use. Less than 1% of the lands in the ES region are owned by county governments.

In summary, all of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

Twelve incorporated towns or cities are in the ES region. Of these, the largest in terms of population are Rawlins, Hanna, and Saratoga. As in the case for Wyoming counties, the statutory authority available for cities to control land use is quite restrictive. Cities have authority to design a master plan zoning, and other regulatory controls. Cities do not have statutory authority to exercise controls over minerals extraction or production within their corporate limits. Furthermore, the Wyoming Environmental Quality Act of 1973 preempts cities' authority to regulate and control air, water, solid waste, and land quality standards except where specifically delegated to a municipality. All of the respective jurisdictions (federal, state, and counties) have sufficient authority to impose effective land and resource use controls.

The zoning in Carbon County is divided into five classes of Districts.

1. Ranching, Agriculture and Mining (R-A-M)
2. Residential Development
3. Retail Business
4. Highway Business
5. Industrial

At present, the proposed project areas are situated in R-A-M districts, with scenic corridors located in the proposed Cherokee and Hanna South project areas (see site specifics for details).

SOCIOECONOMICS

Demographics

Population

The 1977 Carbon County population is estimated to have been 18,137. The population of Rawlins was 10,500 (58% of the county total). This constitutes a 36% increase since 1970 for Carbon County and a 34% increase for Rawlins (Table R2-25).

Employment

The total employment in Carbon County was 8,067 in 1977. The mining sector accounted for 10.5% of the total employment (Table R2-26).

Mining activity in Carbon County is centered in the Shirley and Hanna Basins. The Shirley Basin uranium district is in the northeast corner of Carbon County and contains three active mines. Coal mining in the Hanna Basin, located about 40 miles east of Rawlins in the center of Carbon County, has grown rapidly since 1970 and six mines are now in operation.

The 1977 unemployment rate in the county was very low (3%) reflecting the county's growing employment levels.

Income

The mining sector of the economy accounted for approximately 28% of the total personal income in Carbon County. Other major sectors were business services (19.7%), consumer services (13.5%), and construction (13.5%) (Table R2-27).

Per capita income in 1975 was $6,348 while the average weekly wage was $211.56 (U.S. Department of Commerce 1978). The average 1977 weekly wages ranged from a high of $389.94 in the mining sector to a low of $115.99 in the retail trade sector (Table R2-28).

Infrastructure

Private Sector

Rawlins, the county seat and largest city in Carbon County, is also the major retail center in the county. In 1978 there were an estimated 250 retail businesses and an equal number of wholesale and other non-retail businesses in the county (Rawlins/Carbon County Chamber of Commerce 1978). Rawlins includes both large "convenience goods"(less expensive goods not subject to comparison shopping) establishments such as major grocery and drug stores, and unlike other areas of the county "shopping goods"(more expensive goods subject to comparsion shopping) establishments such as department, furniture, and clothing stores. Retail establishments in other municipalities in the county tend to be smaller, sell only convenience goods, and serve immediately surrounding areas. A third, relatively small group of retail establishments, primarily motels and service stations, are located adjacent to the county's highways and are oriented to travelers.

Total wholesale and retail taxable sales for 1977 were $67.5 million. Wholesale trade accounted for $7.9 million, retail trade accounted for $46.7 million, and services $12.9 million (Wyoming Department of Administration and Fiscal Control 1977). In 1972, Rawlins accounted for 77% of county retail sales (U.S. Department of Commerce 1972).

Local Government

Community revenues come from six major sources.

Property Tax Revenues. Communities may impose a levy of up to 8 mills for general expenses, and may increase levies beyond 8 mills only for repayment of sewer and water bonds. Counties may impose a levy up to 12 mills.

Sales and Other Taxes. Communities are "passed back"funds collected in gasoline, sales and cigarette taxes. Sales taxes are returned to the county where collected and then allocated to communities based on 1970 population. Cigarette taxes are retuned to the jurisdiction where the cigarettes were sold.

Enterprise Revenues. Water and sewer usage charges are the primary source of enterprise revenue. Miscellaneous retails (ranging from property leases to equipment rental) constitute the remainder of enterprise revenues. The funds are generally applied to expenses of the enterprise and do not subsidize general budget expenses.

Federal Transfers. Federal revenue sharing is an important revenue component for many ES area communities. In addition, communities may be eligible to obtain grants or loans to finance infrastructure construction from federal agencies such as the Economic Development Administration, the Environmental Protection Agency, and the Farmers Home Administration.

Mineral Revenues. Communities directly receive 7.5% of mineral leasing royalties received by the state (from federal leases) and the county receives 2.25%. Other portions of the leasing royalties are earmarked for education and roads. Of the 7.5% which goes to communities, $10,000 is given to each incorporated community and the remainder is allocated to counties using the previous year's school enrollment (average daily membership) and thence to communities using 1970 population.

Severance Taxes. State severance taxes are 8.5% of the value of gross production. These taxes accrue directly to the state and are not returned to communities. However, a portion of the severance taxes is passed to the State Farm Loan Board to run a grant and loan program for energy impacted communities.

Other miscellaneous sources of revenue include interest on investments, licenses and permit fees and penalties such as traffic tickets.

For most of the communities in the ES area, enterprise revenues from water and sewer constitute the largest revenue component. These revenues are generally offset directly against water and sewer expenditures in the community budgets. The state collects a 3% sales tax and returns one-third (1%) to the communities based on population. This represents a significant source of income to most communities. In November 1977, Carbon County voters approved an additional 1% sales tax levy which could double the sales tax revenues. (Authority to levy this tax must be reaffirmed by Carbon County voters in November 1978.) Mineral revenues are also an important source of income for ES area communities. These revenues are based primarily on mineral production so only currently operating mines provide mineral revenues. Property tax revenues are more important in the larger

Table R2-29

FINANCIAL CHARACTERISTICS
1977

Jurisdiction	Assessed Valuation	Mill Levy*	Bonded Indebtedness
County			
Carbon	$188,630,804	12.61	$ 159,100
School District			
Number 1	106,958,792	51.804	9,508,000
Number 2	104,128,103	45.124	12,724,000
Communities			
Rawlins	14,505,124	14.76	2,993,000
Baggs	255,290	8.00	None
Dixon	63,843	8.00	20,500
Elk Mountain	202,399	13.00	27,000
Elmo	96,963	12.26	144,000
Encampment	528,175	17.28	43,000
Hanna	1,403,186	11.40	133,000
Medicine Bow	621,144	8.00	40,000
Saratoga	2,584,955	8.00	282,000
Sinclair	4,721,591	8.00	None
Wamsutter	303,480	48.53	198,000

* Per $1,000 assessed valuation.

Sources: Wyoming Taxpayers Association, Wyoming Property Tax Rates, 1977, Cheyenne, Wyoming, August 1977.

Wyoming, State of, Department of Education, 1977 School District Property Valuations, Mill Levies and Bonded Debt, Statistical Report Series No. 1, Cheyenne, Wyoming, September 1977.

City clerks or other officials in the communities shown.

Table R2-30

HOUSING IN INCORPORATED AREAS
TOTAL AND BY TYPE*
1977

County Community	Total Year Round Units	Type of Unit Single Family**	Multiple Family**	Mobile Home**
Carbon County				
Rawlins	3,428	2,034 (.60)	700 (.20)	694 (.20)
Sinclair	203	198 (.97)	0 (.00)	5 (.03)
Hanna	510	325 (.64)	0 (.00)	185 (.36)
Elmo	77	35 (.45)	0 (.00)	42 (.55)
Elk Mountain	95	70 (.74)	0 (.00)	25 (.26)
Medicine Bow	246	100 (.41)	6 (.02)	140 (.57)
Saratoga	765	477 (.62)	87 (.11)	201 (.26)
Encampment	241	155 (.64)	2 (.01)	84 (.35)
Baggs Area***	182	79 (.43)	0 (.00)	103 (.57)
Wamsutter (Sweetwater County)	130	64 (.49)	6 (.05)	60 (.46)
Total Housing in Incorporated Areas	5,877	3,537(.60)	801 (.14)	1,539 (.26)

* Except for the towns of Rawlins, Hanna and Medicine Bow, the data on housing has been taken from Land Use Plans submitted by the communities to the Carbon County Council of Government in the fall of 1977. Although the figure on the total housing units in Rawlins was taken from a Land Use Plan, data on the type of housing was estimated from conversations with local officials. Housing figures for Hanna reflect estimates reported by the local town clerk. Total housing units for Medicine Bow reflect the results of a survey conducted by the local high school students in the spring of 1977. Figures on the type of units in Medicine Bow were estimated based on conversations with local officials.

** Figures in parenthesis are the fraction of total housing units. These figures may not add to 100 due to rounding.

***

Table R2-31

PUBLIC SCHOOL CHARACTERISTICS

1977-78

School District School (Grade)	Student Enrollment	Full-Time Equivalent Teachers	Student/ Teacher Ratio	Building Design Capacity
School District #1				
Mountain View (K-6)	368	18	20.4	460
Pershing (K-6)	282	15	18.8	370
Sunnyside-Central (K-6)	465	14	33.2	488
Baggs-Morrow	213	16	13.3	275
Bairoil (K-8)	65	6	10.8	110
Sinclair (K-6)	65	3.5	18.6	140
Rawlins Jr. High (7-8)	387	22	17.6	525
Rawlins High (9-12)	823	47	17.5	1,000
School District #1 Total	2,668	141.5	18.8	3,368
School District #2				
Elk Mountain (K-6)	39	3	13.0	140
Encampment (K-12)	214	14	15.3	300
Hanna (K-6)	276	13	21.2	300
McFadden (K-8)	16	3	5.3	100
Medicine Bow (K-6)	114	7.5	15.2	150
Platte Valley (K-6)	275	16.5	16.6	300
Shirley Basin (K-6)	79	7.5	10.5	140
Beer Mug (1-6)	2	1	2.0	--
Hanna-Elk Mountain Junior-Senior High (7-12)	200	15	13.3	300
Medicine Bow-Shirley Basin Junior-Senior High (7-12)	153	13	11.7	400
Platte Valley Junior High (7-8)	91	6.5	14.0	300
Platte Valley High (9-12)	199	10	20.0	
District #2 Total	1,658	110	13.1	2,430
Carbon County Total	4,326	251.5	16.0	5,798

Sources: Wyoming State of, Department of Education, Division of Planning, Evaluation and Information Services, Fall Report of Staff/Teachers/Pupils/Enrollments 1977, "Statistical Report Series, No. 2", 1977, Cheyenne, Wyoming.

Wyoming, State of, Department of Education, Communications Services, Wyoming Education Directory, 1977-78, Cheyenne, Wyoming, 1977.

Telephone conversations with Hugh Simmons, School Superintendent, District #1, March 22, 1978; and John Tynon, School Superintendent, District #2, March 22, 1978.

the county, and has capacity for a population of 29,000 to 33,000. The hospital operates an emergency room and eight ambulances; two assigned to the hospital and six to outlying towns in the county. Ambulance service is considered adequate to meet the needs of county residents. There are, in addition, two other primary (i.e., full-time) and one secondary (i.e., reserve) ambulances in the county (Wyoming Department of Health and Social Services 1978). Rawlins has two small private medical clinics and a third private clinic is located in Saratoga. None of the clinics are formally associated with the county's hospital (Hospital Administrator, Memorial Hospital of Carbon County).

In 1977, the hospital's occupancy rate was 28%, a sharp decline from the 1974 occupancy rate of 55% (Wyoming Department of Health and Social Service 1978, 1976). According to the hospital's administrator, occupancy rates have declined or been at low levels for two reasons. First, the length of stay for a patient at the hospital is about 4 days compared to a national average of between 7 and 8 days (American Hospital Association 1977). Second, between the spring of 1973 and the fall of 1975, the county lost eight practicing physicians through death, retirement, or relocation out of the county. In 1974 and much of 1975, there were only three physicians practicing in the county who were admitting patients to the county hospital. As a consequence of the scarcity of physicians able to treat patients at the county hospital, referrals were made to other hospitals and some county residents went directly to other hospitals for treatment.

Since November 1975, the hospital and the county government have had a recruiting program to bring physicians to the county. Physicians recruited by the program are guaranteed an income for their first year of practice under the program. According to the hospital administrator over half of the seven physicians now practicing at the hospital have been recruited through the program. These efforts to increase the number of practicing physicians have been frustrated by a high turnover rate among recruited doctors who choose not to renew their one-year contracts with the hospital.

Although there is only one hospital in Carbon County, the hospital's service area does not include the entire county. Residents in the southwestern section of the county including the towns of Baggs, Dixon, and Savery are closer to and served by the hospital in Craig, Colorado. Those in the eastern section of the county travel to the hospital in Laramie. Carbon County's hospital also refers patients to hospitals in Lander and Casper which offer specialized medical services unavailable in Rawlins. For major surgery, patients are referred to hospitals in Denver.

Table R2-32 indicates the number of practitioners in the various health professions in Carbon County during 1977. As those data show, the number of doctors and dentists in the county, when measured against recommended standards, are inadequate to meet health needs. Only the standard for registered nurses was met (Wyoming Department of Health and Social Service 1976, 1978).

Local Services

With some exception, all municipalities provide police, fire, water, sewer, and solid waste services. The exceptions are noted in the discussion of each municipality below. Most local officials interviewed considered police and fire protection to be adequate. Local police protection is augmented in most municipalities by members of the County's Sheriff's Office or the State Highway Patrol who live in those municipalities. Municipalities' fire protection ratings are made by the Insurance Services Office of Denver, Colorado in determining fire insurance rates. Only Rawlins and Sinclair are rated as having adequate fire protection (Class 7). All other Carbon County municipalities are rated as having inadequate fire protection (Classes 8, 9, and 10) because of inadequate equipment, water service, or lack of an organized fire department. All water systems in the county are publicly owned. Water and sewer services are the highest priorities of most local officials and are the areas most often undergoing improvements. For the majority of communities there is no collection service for solid waste. Local officials generally considered existing disposal sites adequate to meet current and near term future needs.

Current improvements to services, adequacy of those public services, current problems, and other information are highlighted below for each jurisdiction.

Carbon County. The Carbon County Sheriff's Office provides police protection in unincorporated areas of the county and support to local police departments (Undersheriff Carbon County Sheriff's Office 1978). Deputies (full-time and/or part-time) are located in Rawlins, Hanna, Elk Mountain, Medicine Bow, Saratoga, Baggs, Arlington, Shirley Basin, and Bairoil. In addition to the 22 full and part-time deputies on its staff, the Sheriff's Office has deputized some members of local police departments and the State Highway Patrol. The Sheriff's Office operates on a 24-hour basis which places strains on available staff. Demands on services have increased sharply in the past year. In that period, drug arrests by the Sheriff's Office increased 250%, the number of prisoners handled increased by 30%, and civil complaints rose sharply. The County's Undersheriff, however, indicated that the Sheriff's Office was adequately meeting needs and that increased demands were not resulting in decreases in the quality of service.

Carbon County has a volunteer fire department (Fire Marshall, Carbon County 1978). Volunteers also serve as members of local fire departments. Fire equipment is located throughout the county. A significant proportion of this equipment dates from the 1940s and 1950s and is in need of replacement. The major inadequacy of this department is its inability to extinguish major fires requiring chemical or foam equipment. For such fires a private fire company in Casper is used.

Rawlins. The major problem with the Rawlins' police department is inadequate facilities. According to the Police Chief, the facilities were adequate when the staff numbered eight officers in 1972. With more than twice that many officers today, paperwork and records have increased to the point where 25% of the jail is being

Table R2-26

EMPLOYMENT BY SECTOR - CARBON COUNTY*

Sector	1977 Employment	Percent of Total
Farm	526	6.5
Manufacturing	360	4.5
Mining	1,658	20.5
Construction	715	8.9
Government	919	11.4
Farm & Forest Processing	46	0.6
Railroads	480	6.0
Business Services	1,415	17.5
Consumer Services	1,948	24.1
Total Employment	8,067	100.0

Note: Employment figures shown represent the number of people living in Carbon County who are employed in one or more jobs. This corresponds to the definition of employment used by the U.S. Bureau of the Census.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, 1978.

Table R2-27

PERSONAL INCOME BY SECTOR - CARBON COUNTY
(thousands of constant 1977 dollars)

Sector	1977	Personal Income 1977 percent of total
Manufacturing	4,563	5.0
Mining	25,944	28.4
Construction	12,291	13.5
Government	11,005	12.1
Farm and Forest Processing	465	.5
Railroads	6,714	7.4
Business Services	17,934	19.7
Consumer Services	12,280	13.5
Total Wage and Salary Income	91,196	100.1
Total Personal Income	147,094	-
BEA Personal Income	NA	-

NOTE: Personal income figures are by place of residence. Total personal income includes wage and salary income, agriculture salary income, proprietors' income, other labor income (such as employer pension contributions) and other income (such as government transfer payments).

Sources: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, 1978. The model's estimates are in constant 1973 dollars which were adjusted to constant 1977 dollars using the Western State Consumer Price Index (U.S. Bureau of Labor Statistics). Proprietors' Income was adjusted to reflect trends in Carbon County.

U.S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income 1970-1975, August 1977. The figures shown were adjusted to constant 1977 dollars using the Western States Consumer Price Index (U.S. Bureau of Labor Statistics).

Table R2-28

AVERAGE WEEKLY WAGE BY NON-AGRICULTURAL SECTOR - CARBON COUNTY

	Year						
Sector	1970	1973	1974	1975	1976	1977	Average Annual Change (1970-76)**
Manufacturing	161.16	187.81	229.69	264.84	312.96	273.15	11.7
Mining	196.22	233.27	269.67	332.75	377.24	389.94	11.5
Contract Construction	139.55	204.38	221.39	241.05	245.85	255.16	9.9
Wholesale Trade	110.58	126.25	177.75	170.04	182.00	191.58	8.7
Retail Trade	70.08	72.96	93.18	114.21	113.44	115.99	8.4
Finance, Ins. & Real Estate	105.82	122.27	142.29	173.01	175.76	188.81	8.8
Trans., Comm., & Public Utilities	146.31	180.30	188.34	232.06	244.53	258.22	8.9
Services, includ. Agriculture, Forestry & Fisheries	65.40	80.33	86.57	98.96	106.30	124.05	8.4

* Based on monthly data for January 1977 through June 1977.

** This is the average annual rate of change (percent) between 1970 and 1976.

Sources: Wyoming Employment Security Commission, Administrative Services Division, Research and Analysis Section, Casper, Wyoming.

communities and the county than smaller communities which have a smaller assessed value base. Finally, in a number of ES area communities federal assistance programs have been a major source for financing major infrastructure improvements. Medicine Bow and Wamsutter have programmed federal assistance in their 1977 to 1978 budgets; Rawlins is anticipating assistance from agencies including the Farmers Home Administration and the Environmental Protection Agency, which are not included in their budget figures; and the communities of Hanna, Elmo, Encampment, Dixon, Baggs, and Savery have all received federal or state assistance recently.

Table R2-29 presents current (fiscal year 1977) assessed values, mill levies, and bonded indebtedness for the region's jurisdictions. The bond ceiling, which is the maximum amount of debt that a jurisdiction may incur, is based on the assessed value for the current year. Communities may not issue general revenue bonds for greater than 4% of assessed valuation and sewer bonds for an additional 4%. There is no bond ceiling for water bonds. Counties are limited to 2% of assessed value and school districts are limited to 10%.

Housing

Total year-round housing units in Carbon County were 6,160 in 1976. Approximately 16% (1,016) of these were mobile homes. Total housing units in Rawlins were 3,428 in 1977 of which 20% (694) were mobile homes (Centaur 1978).

Total housing units and types of unit (single, family, multiple family, mobile home) for the incorporated areas of Carbon County are shown on Table R2-30.

The popularity of mobile homes can be explained by some of the following factors. First, they are a fast, economical means of obtaining lodging. Second, alternatives such as conventional "stick built"homes and modular homes have been scarce and are expensive. The price of a three bedroom modular home with an unfinished basement is approximately $50,000 to $55,000. Conventional "stick built"homes carry prices of $60,000 and up. By comparison, a three bedroom mobile home costs $13,000 to $14,00 (Schaler 1977).

Education

There are two school districts in Carbon County. School District 01, with headquarters in Rawlins, basically comprises the western half of the county. School District 02, with headquarters in Saratoga, handles the eastern half of the county.

There are nine schools in School District 01: seven elementary schools (distributed fairly evenly among the towns in the district); one junior high in Rawlins; and two high schools, Rawlins and Morrow (located in Baggs). A new junior high is being built in Rawlins with a projected capacity of 850 students in the sixth through eighth grades. Sixth graders now being taught in the Rawlins elementary schools will be transferred to the new junior high, relieving some of the crowding in the elementary schools, which are currently operating at 87% to 90% capacity. The new school is scheduled to open in September, 1978. Officials hope to begin construction of a new elementary school in 2 or 3 years to accommodate the increase in elementary school aged children indicated by the population projections available to the district.

The 1977 to 1978 pupil/teacher ratios in School District 01 are almost equal to the statewide average (Table R2-31). The staff turnover rate (approximately 15%), according to the superintendent, is not abnormally high and there is no difficulty in attracting new staff.

School District 02 includes the widely scattered small communities located in and near the Hanna Basin coal mining area. Because of a lack of geographic cohesiveness in the district, more schools are required to serve a considerably smaller school-aged population than in School District 01. A total of thirteen schools serve School District 02, including two one-room elementary schools (Beer Mug and Sand Lake) with a total enrollment of eight children. (Arrangements are presently being made to close these schools within the next 2 years and transport the pupils to the nearest graded elementary school.) The remainder of the schools are located in the various towns in the district.

At present, the greatest impact of the mining activity in the Hanna Basin is being felt in the Saratoga and Hanna schools. The sixth through ninth grades have been most affected. Plans for the immediate future include new high schools with student capacities of 400 each for Saratoga, Hanna, and Medicine Bow, the latter two to be underway soon and open by September, 1979.

Changes in the character of the population has also affected the school system. The transient nature of the families who migrate to the mining area has increased the need for special education programs, including more "special ed"teachers. Ordinary handicapped children can be handled by existing programs, but the district is transporting children with more serious learning disabilities to larger special facilities in neighboring counties (Tynon 1978).

Pupil/Teacher ratios in District 02 are quite low compared to the statewide average (Table R2-31). However, these figures do not necessarily indicate that the quality of education in the district exceeds that for the state as a whole. In several small schools (e.g., McFadden, Shirley Basin, Beer Mug, Sand Lake), there is a teacher to serve only a handful of students, resulting in a very low pupil/teacher ratio. This may distort the overall average pupil/teacher ratio.

Health Care

Carbon County is designated a medical scarcity area by the Wyoming Department of Health and Social Services. The designation is based on the scarcity of practicing physicians.

The major health care facility in Carbon County is Memorial Hospital of Carbon County which is located in Rawlins. It is the only source of inpatient medical care in

Table R2-32

HEALTH CARE PERSONNEL - CARBON COUNTY

Health Care Specialist	1977 Specialist	1977 Population Per Specialist*
Physicians	9	2,015
Primary Care Physicians	6	--
Specialists	3	--
Dentists	7	2,591
Psychologists	1	--
Registered Nurses (Employed)	69	263
Licensed Practical Nurses (Employed)	33	--
Pharmacists	19	--
Professional Mental Health Counselors	3	6,046

*Only shown where a standard for population per specialist exists. Standards identified in Wyoming Health Profiles 1976 are 1000 population per physician 1,600 population per dentist and 285 population per registered nurse. The standard for professional mental health counselors was provided by the Director of the Carbon County Mental Center at one professional per 3,500 - 4,000 population.

Source: Wyoming Health Profiles 1976 and Wyoming Health Profiles 1978, Wyoming Department of Health and Social Services, Cheyenne, 1976 and 1978.

used to store records. The department is now considered understaffed by the Police Chief and staff turnover because of high wages paid to miners adds to personnel problems. Requests for additional officers and vehicles will be made to the city, but as of March, 1978 no budget hearings had been scheduled and funding was uncertain.

The largest potential problem in fire protection service in Rawlins is low pressure in the water system, particularly during the summer when demands for water peak (Rawlins Fire Department). Low pressure has not led to major problems in the past and current improvements to the water system should alleviate these conditions. Four of the six existing firefighting vehicles are over 25 years old. The Fire Chief would like to improve the department's facilities, equipment, and paid staff; however, available funds are limited. A fall 1978 vote to reaffirm the additional 1% local sales tax could endanger the $50,000 that the department receives from the additional sales tax revenues. Rawlins' fire protection rating is seven which is considered adequate (Insurance Services Office).

The Rawlins water system is currently undergoing its first improvements in 23 years (Rawlins Water Department). A $2 million project guaranteed by the Farm Loan Board is installing new mains from the reservoir supplied by the North Platte River to the city's system and constructing a 3 million gallon storage tank to increase water supplies and storage. A $1 million project using Farmer's Home Administration and Farm Loan Board funds will expand reservoir capacity by 350 million gallons and is designed to meet water needs of the city until the year 2000 based on current growth rates. A grant of $220,000 from the Economic Development Administration funded other improvements designed to increase the system's pressure.

Rawlins' present sewer system is being improved to correct major inadequacies (Nelson Engineering). At present, 60% of sewage is discharged untreated into Sugar Creek. A $4 million (75% Environmental Protection Agency funded) project is installing new 24-inch interceptor sewers and will construct (by spring 1979) a new lagoon designed to serve a population of 23,000. These improvements will significantly upgrade the system; however, the system will continue to have problems with old, undersized sewer lines that are overloaded with groundwater seeping into older lines.

Sinclair. Police and Fire protection in Sinclair are considered adequate. Both services can be augmented, when necessary, by other organizations in or near Sinclair. The Little America Oil Corporation's Refinery located in Sinclair has its own fire department. The Carbon County Sheriff's Office in Rawlins can provide support to Sinclair police department.

The adequacy of the town's water and sewer services is the object of a study currently being made by Sage Engineering of Greeley, Colorado for the town. (Concern with the adequacy of the town's water system led to a moratorium in September, 1976 on new hookups to the water and sewer systems. The moratorium was lifted in May, 1977 to allow for sixteen new hookups and as of March, 1978 six such hookups had been made.) At present, peak water demands can be met and the study is primarily focused on future needs resulting from potential population growth.

The refinery is an important factor in Sinclair's delivery of services since it maintains the town's water system, owns the lagoon where the town's sewage is treated, and owns the landfill used by the town. The landfill has an estimated remaining life of 2 years.

Hanna. Turnover in the police department is an ongoing problem since those hired frequently quit to work in mining because of the high wages paid to miners. Local police protection is augmented by one full-time and one part-time county deputy who live in Hanna.

The town's fire department has access to three county fire department vehicles located in Hanna to supplement town-owned equipment.

Hanna is currently undertaking a $2 million (Farm Loan Board, Farmers Home Administration, and local funds) project to improve its water system. Sections of the 12-mile water main from the town's water supply source, Rattlesnake Creek, are being replaced and new storage capacity is being added. These improvements are designed to meet current needs only and are expected to eliminate the need for water restrictions which have been imposed regularly in the past during summer months.

In the fall of 1977, the town built a new sewage treatment lagoon. The lagoon is designed to accommodate approximately 4,000 to 5,000 persons.

Elmo. Elmo has no fire or police department. Fire protection is provided by the town of Hanna; police protection is provided by the county Sheriff's Office.

Elmo's water is also supplied by Hanna and in the past the town has been subject to the same summer water restrictions imposed in Hanna. Improvements to Hanna's water system should eliminate the need for these restrictions. With the help of a Farmers Home Administration loan, Elmo built a new 100,000 gallon water storage tank which should solve most of the towns problems with low water pressure. The Farmers Home Administration loan also helped to construct a new lagoon for sewage treatment.

Elk Mountain. The Elk Mountain volunteer fire department has tentative plans to acquire an additional fire truck. No funds, however, have been allocated for an additional truck. The town's water system is considered adequate only for present needs and additional water sources—other artesian wells and the town's water rights in the Medicine Bow River--have been explored. No commitment to develop these sources has been made. Elk Mountain is the only incorporated area in the county which relies on septic tanks for sewage treatment. With the current population, septic tank leachate is not considered a major problem. The town has had preliminary engineering and cost estimates made for a sewer system, but has been unable to find sources of funding for the system.

Medicine Bow. Water service has been the most critical problem in the delivery of local services in Medicine Bow. In the summer of 1977 the town rationed water

and expects to do the same in the spring of 1978. By mid-summer of 1978, current improvements to the water system should correct water supply problems. A $2 million project funded by the Farmers Home Administration and the Farm Loan Board will provide the town with a new artesian well, install new mains from the well to the town, and construct a 1.5 million gallon water storage tank.

The town has recently built a new sewage treatment lagoon. The lagoon's capacity is more than adequate to serve current needs.

Saratoga. Saratoga is in the process of making improvements to its water and sewer systems. Improvements to the water system include a water treatment plant and a new 1 million gallon storage tank. These improvements allowed the town to lift a 15-month moratorium on building caused by inadequacies in its water system. Bids for the installation of new sewer lines were let in April, 1978, and new aerators at the town's lagoon have been installed. The lagoon, however, cannot adequately treat the amount of sewage generated by the town and is currently operating at about 105% of capacity.

Police and fire protection are adequate to meet the community's needs. In August, 1978, Saratoga will begin using a new solid waste disposal site with a 20-year capacity.

Encampment. Encampment has grant and loan commitments of $252,000 from the Farmers Home Administration for improvements to its water system. These improvements will include a new well to complement the town's water supply from the North Fork of the Encampment River and a new 500,000 gallon water tank. Water supply is a major problem in Encampment. Water shortages resulted in a building moratorium between July and October of 1977. Other local services are adequate or more than adequate to serve present needs.

Dixon. The town of Dixon has recently added new storage capacity and new water mains to its system to correct problems with lack of storage and low pressure. The improvements cost $200,000 with the Farmers Home Administration providing a grant and loan covering 90% of cost.

While Dixon has no local police department, police protection is provided through the County Sheriff's Office. Other local services are adequate to meet present demand.

Baggs. The town of Baggs is now planning water and sewer improvements. By June 1978, a new well with a pumping capacity of 288,000 gallons per day will be completed, a new 383,000 gallon storage tank will be added, and new water lines will be installed. If sufficient funds remain, a lagoon with treatment capacity sufficient for a population of 1,500 will be constructed in the summer of 1978. Other local services are adequate to meet present needs.

Transportation and Utilities

Road Systems. Southcentral Wyoming is served by a network of federal, state and local roads. The major roads in the area are shown on Map 13 in Appendix A. Interstate 80, connecting the area with Utah to the west and Laramie and Cheyenne to the east, is the only four lane, divided, fully controlled access road. It is subject to periodic closing in the winter months due to poor weather conditions. U.S. 30 (and 287) from Walcott Junction northeastward through Hanna Junction and Medicine Bow to Albany County and U.S. Highway 287 northward from Rawlins are the two U.S. highways in the area. Both are two lanes and paved. U.S. 30 from Medicine Bow to the Albany County line has been identified by the Wyoming Highway Department as presently needing to be widened and reconstructed in spots. Other sections need to be resurfaced. None of the work has been programmed (programmed projects are those projects which have been scheduled on the Highway Improvement Program).

Several state highways serve the area. Wyoming 789 from Creston Junction on the north to Baggs on the south is a two lane paved road. The Wyoming Highway Department identifies sections of this highway as presently needing to be widened, resurfaced, or reconstructed. The work for the section to be reconstructed, from north of the Baggs city limits to the Colorado state line, has been programmed. The deficiency has been recognized on the remaining section, but no work has been scheduled.

Wyoming 71 runs from Rawlins southward for 17 miles. It is a two lane paved road. Sections presently need to be reconstructed. After 17 miles, Wyoming 71 becomes Sage Creek Road, a two lane gravel road running southward to the Medicine Bow National Forest where it intersects with Wyoming 70. The road through the forest is closed during the winter. Wyoming 70 runs from Baggs eastward through Dixon, Savery, and the Medicine Bow National Forest to Encampment. It is a two lane road that is paved from Baggs to the National Forest and for 2 to 3 miles west from Encampment. From within the forest to outside of Encampment, the road has a gravel surface. The Wyoming Highway Department identifies Wyoming 70 from Savery to Encampment as presently needing to be reconstructed. The work has not been scheduled. Wyoming 70 through the national forest closes during the winter months.

Wyoming 130 runs south from Walcott Junction to Cow Creek, midway between Saratoga and Riverside, where it turns east through the Medicine Bow National Forest. It is a two lane paved road that closes to traffic through the forest in the winter. Sections of this road have been identified as presently needing to be reconstructed. Some work has been programmed.

Wyoming 230 runs south from Cow Creek to the Colorado border. It is a paved, two lane road. Sections presently need to be reconstructed, resurfaced, or widened. The work has not been programmed.

Wyoming 72 runs from Elmo south to the town of Elk Mountain. It is a paved, two lane road with passing lanes in places. Sections have been programmed for reconstruction.

Wyoming 487 is a two lane paved road from Medicine Bow to the Shirley Rim area. Sections need widening

and isolated reconstruction. The work has not been programmed.

Wyoming 13, a two lane paved road, runs from Arlington northeastward to the Albany County line. It is in excellent condition from Arlington to McFadden. There are some deficiencies from McFadden to Rock River in Albany County.

Interstate 80, which is one of the principal interstate routes crossing the United States, is the most heavily travelled road. Wyoming 789, U.S. 287 north of Rawlins is well travelled, while other roads in the ES area are lightly used. Hanna Basin coal miners travel either west on U.S. 30 to Walcott (then along I-80 to Sinclair and Rawlins or along Wyoming 130 to Saratoga and Encampment), south on Wyoming 72 to Elk Mountain, or east on U.S. 30 to Medicine Bow. Mine traffic is concentrated in Hanna and is heaviest when mine shifts change at 8:00 a.m., 4:00 p.m., and midnight. Even during these times, congestion is slight (McGuire 1978).

Local roads provide access from the main highways to other portions of the area. They generally serve local traffic only and are not normally used for commuting or through traffic purposes. Local roads, therefore, have a minor role in the overall road network. Generally, local roads are two lanes and unpaved with great variation in their actual width and condition. Among the gravel roads in the area are: Pass Creek Road from Wyoming 130 east to the town of Elk Mountain, Jack Creek Road from Saratoga to Sage Creek Road, Riner Road from I-80 northward, the Difficulty-Medicine Bow Road, and Sweetwater 4-63 from the Minerals Exploration site to U.S. 287, 13 miles north of Rawlins. The Cedar Creek Road is gravel from Saratoga to about halfway to Tenmile. It is dirt the rest of the way to Tenmile. The Twenty Mile Road (Carbon County 605) from Wyoming 789 north to Wamsutter and the Crook's Gap-Wamsutter Road also serves local access. Some local roads are primitive and impassible during bad weather. The Continental Divide Road from Wyoming 789 east to Twenty Mile Road is currently unimproved, although a proposal to upgrade it has been made.

Commercial Railroads. The Union Pacific Railroad's main line through southern Wyoming transports current coal production in the Hanna Basin. Estimated rail traffic capacity and 1977 train volume are presented in Table R2-33. As can be noted, 1977 traffic represented about 60% of available capacity. Capacity figures should not be considered as absolute. Numerous factors such as grades, running speeds, congestion in yards or terminals at segment end points, and the "mix"of hot trains, manifest trains, and unit trains which vary in speed as well as operating characteristics, can alter the capacity figures (Union Pacific Railroad Company 1978).

Coal production and unit train traffic reported for the Hanna Basin in 1977 are shown on Table R2-34. Nearly all the coal produced currently in the Hanna Basin is carried eastward through Nebraska towards market destinations. A small amount, less than one train per day (including empties) originates in southwestern Wyoming and adds to the coal traffic moving towards Nebraska.

Impacts of coal train traffic are felt not only in the immediate area of coal production (i.e., near the mine), but also where train traffic increases as coal is moved towards its market destinations. Communities along the U.P. route feel the impacts of rail traffic in a variety of ways.

If communities have developed around the railroad tracks, they could be temporarily divided by passing trains. Traffic delays occur at railroad/highway crossings, creating an inconvenience to local residents. Essential services such as hospital, fire, and police services may also be detained at railroad crossings. In some communities, in addition to acting as physical barriers, rail lines represent social barriers as well. This occurs when train traffic isolates certain sectors of a community from the central part of town.

Trains create noise and air pollution and railroad-related automobile and pedestrian accidents at railroad crossings.

Communities as far east as Grand Island, Nebraska were polled about possible adverse impacts due to coal related traffic. Coal trains begin to branch at Kearney, Nebraska, reducing traffic volume east of Kearney. Grand Island was contacted because it is a junction between two major coal train routes, the Union Pacific main line leading from the Hanna Basin, and the Burlington Northern main line leading from the Eastern Powder River Basin mining area. Since non-coal freight traffic was already heavy along the U.P. main line, recent coal train traffic has not substantially increased the level of impacts in these communities. The exceptions occur in the communities of Sidney, Nebraska, Julesburg, Colorado, and Grand Island, Nebraska. In these cases, the addition of coal trains causes major problems in vehicle and pedestrian movement.

Passenger Transportation. Amtrack provides passenger railroad service from Rawlins to Laramie, Cheyenne, and other cities to the east and to Rock Springs and other cities to the west. Scheduled service is one eastbound and one westbound train daily.

There are four airports in Carbon County located in Rawlins, Saratoga, Dixon, and Hanna. The Rawlins airport is located 2 miles northeast of the city's center. Daily scheduled service is provided by Trans Mountain Air to Casper, Laramie, Rock Springs, Saratoga, and Denver, Colorado. The Rawlins airport runway is paved with a length of 5,500 feet. An application has been made to the Federal Aviation Administration (FAA) for grant funds to extend the runway to 8,400 feet and make other improvements to airport facilities. According to the airport manager, extending the runway would increase service at the airport by allowing larger jets to land. The airport in Saratoga was recently awarded a $750,000 grant by the FAA to strengthen the existing 8,400 foot paved runway. Construction is to begin in May, 1978. The airport manager indicated that this would allow larger and heavier planes to land and should contribute to increased traffic at the airport. The Saratoga airport is primarily used by charter services and private planes; Trans Mountain Air provides service on an as-needed basis. The other two airports, located out-

Table R2-33

RAILROAD TRACK CAPACITY AND CURRENT TRAFFIC

Segment	Number of Tracks	Signaling*	Length (miles)	Estimated Capacity	Current Traffic (Trains per day)
Rawlins to Hanna	2	CTC	40	70-80	45
Hanna to	3	CTC	35	100-115	
Cheyenne	2	CTC	108	70-80	51
Cheyenne to	2	ABS**	182	55-60	
North Platte	2	CTC	43	70-80	47
North Platte to	2	ABS***	100	55-60	
Gibbon	2	CTC	8	70-80	53
Gibbon to Council Bluffs	2	ABS	176	55-60	34
Gibbon to	1	CTC	203	25-80	
Topeka	2	CTC	17	70-80	22
Topeka To Kansas City	2	ABS	68	55-60	44

*There are two basic types of signalization, automatic block signals (ABS) and centralized traffic control (CTC).

**Installation of CTC is currently underway and should be completed by the end of 1979. With CTC the capacity of the segment will be 70 to 80 trains per day.

***Installation of CTC should begin in this segment upon completion of the CTC project between Cheyenne and North Platte. CTC will increase the capacity to 70 to 80 trains per day.

Source: Union Pacific Railroad Company May, 1978

Table R2-34

COAL PRODUCTION AND RELATED RAILROAD TRAFFIC

Existing Mines	Annual Coal Production MM Tons/Year	Number of Unit Trains *	Market Destination**
Medicine Bow	2.5	250	Kansas, Iowa, Indiana
Rosebud	2.0	200	Wyoming, Nebraska Iowa, Colorado
Seminoe I	2.3	230	Kansas, Illinois, Wisconsin
Seminoe II	3.0	300	Kansas, Illinois, Wisconsin
Vanguard-Rimrock	0.4	40	Iowa
Total	10.2	1,020	

1977 daily average = 1,020 trains per year ÷ 365 = 2.79 trains per day eastbound (loaded), 2.79 trains per day westbound (empty).

* A unit coal train usually consists of 100 coal cars and five diesel units. Each car carries 100 tons of coal.

** Based on contracts reported in Western Oil Reporter, "List of Active, Planned Coal and Uranium Mining Operations is Lengthening," February, 1978.

Source: U.S. Department of the Interior, Bureau of Land Management, Mining and Reclamation Plans, 1978.

side Hanna and Dixon, have unpaved runways, and are used only by private planes (Donnelly Corporation 1978).

Interstate bus service is available on a daily basis. The bus depot in Rawlins is served by Continental Trailways, Greyhound, Central Wyoming Transportation, and Zanetti Bus and Fast Express (Russel's Railway and Motor Bus Guide Company 1977).

Utilities. Carbon County is served by four electric utilities: Pacific Power and Light Company, an investor-owned company which serves Rawlins and surrounding communities; Carbon Power and Light, a rural electric cooperative, which serves Saratoga, its surrounding area, and part of Albany County; Yampa Valley Electric, which serves the southwestern section of Carbon County; and Hot Springs REA.

Northern Gas Company and Mountain Fuel Supply Company distribute gas to Carbon County. Mountain Fuel Supply Company provides service to the southwestern section of the county; Northern Gas Company provides service to remaining sections of the county.

Propane, which is an important source of fuel for rural residents and newly arrived residents who do not have access to natural gas, is distributed by three companies in Carbon County. B-1 Oil Company and Butane Power and Equipment Company are located in Rawlins; Cal-Gas is located in Saratoga. The southwestern section is served by a Colorado company. Some major non-residential customers are served by out-of-county distributors. In March, 1978, the price of propane was between $.41 and $.42 per gallon. The use of propane has increased recently as the number of new residents has outpaced the ability of natural gas distributors to extend service. Propane distributors, however, have been able to expand services to meet these demands.

Fuel oil is not used as a residential fuel in Carbon County. However, according to the manager of utilities for the Little America Oil Corporation, the Sinclair Refinery does provide fuel oil directly to mines in the county.

Mountain States Telephone Company, a part of the Bell System, serves all of Carbon County with the exceptions of Medicine Bow and Baggs. Medicine Bow service is provided by Medicine Bow Telephone Company, and in Baggs service is provided by Valley Telephone. Both companies are independent telephone companies.

Attitudes and Expectations

The attitudes reflected in this section were derived from the Hanna and Overland Planning Unit Planning Area Analyses and some limited opinion surveys that have been completed in the region.

General Attitudes

In October 1974, the Wyoming Conservation and Land Use Planning Commission published a resident survey done as preliminary work in formulating a land use program in Wyoming. From the replies, it could be seen that in 1974 the people of Carbon County wanted land use planning and that both economic and environmental effects should be considered in that planning. They also preferred attracting non-mineral industries over mineral industries, and did not want any development to be at the expense of unique scenic beauty.

In 1975, T. A. Bougsty sampled opinion of residents in the Hanna Basin. This study, done for the Wyoming State Department of Economic Planning and Development, explored residents' preference on the size of their communities and satisfaction with various community services. It was found that 73% of the residents of Elk Mountain prefer no growth, while residents of Hanna and Elmo would tolerate some growth. Satisfaction with community services varied somewhat between communities and the Basin as a whole, with medical services, natural gas supply, streets and roads, community beautification, and recreation facilities being those services the residents were most dissatisfied with.

Information regarding the attitudes of residents in other areas of the Hanna Planning Unit is not presently available.

A resident survey covering the Overland Planning Unit was done in 1976 by Bickert, Browne, Coddington, and Associates. Among other things, residents were asked to rate adequacy of various community services. The results showed that only five services were rated 'very adequate' by 10% or more of the sample. These were fire protection, schools, utilities, roads and highways, and trash disposal.

Specific Attitudes

The following attitudes were derived from material contained in the Overland and Hanna Planning Area Analyses:

1. Forest Management: The timber industry, including the Wyoming Wood Producers Association, supports a continued timber sale program: large sales are desired.
2. Access: Hunting and recreation groups strongly support a program to obtain access in checkerboard land areas and other areas where private lands block access to public lands. Groups such as the Carbon County Conservation Club and the Wyoming Game and Fish Department support programs to obtain access.
3. Livestock organizations support a freeze or cutback of grazing fees on public lands. Most operators desire to have increased flexibility with respect to use of grazing allotments, in terms of class of stock, numbers of stock, season of use, etc. Most operators favor predator control and strongly favor management of wild horses and return of wild horse numbers to 1971 levels.

Lifestyles

Lifestyle means an internally consistent way of life or style of living that reflects the attitudes and values of an individual or a culture. It is influenced by infrastructure (housing, health care, educational system, police and fire protection, etc.) existing at the time.

Many changes are already occurring in the lifestyles of the region's residents. These changes are most evident in Rawlins, which has grown 34% since 1970. This is an annual growth rate of approximately 5%. Any community growth of 5% or more is problematic and could be considered a boom situation (Gilmore and Duff 1974). As identified in the Construction Worker Profile Final Report, 1975, one of the adjustments communities have made in response to this growth has been in the area of role switching. This role switching can take several forms: (1) New roles are created; (2) More positions within existing roles are created; (3) Old roles are redefined in light of changing needs; and (4) Newcomers replace oldtimers in existing roles.

New Roles Created

The most common creation of new roles was in the local economic order, as businesspeople started business not previously present in the community.

Positions Are Created Within Existing Roles

More people are hired to increase employment in occupations already existing in the community. More teachers are hired as enrollment picks up, more waitresses are hired as business increases, etc.

Old Roles Are Redefined

As institutional responsibilities change, old roles get redefined. A merchant's role is changed as he or she is forced to update merchandising, advertising, or financing. Social workers suddenly find themselves confronted with problems they never encountered before. In many cases these changes are such that former role occupants can not or will not make the change and vacate the role.

Newcomers Replace Oldtimers in Existing Roles

In some communities, the oldtimers are unable or unwilling to keep up with the changes demanded of them. Very often a newcomer to the community will take over the role.

Cultural changes are also occurring in the region's communities. As the towns grow larger, they become less relaxed, friendly, traditional, isolated, harmonious, and run down. At the same time they become more expensive, difficult, progressive, and competitive. The communities are becoming more diverse culturally as new people bring in new ideas. In addition, more professionalism and respect for expertise occurs along with specialization and more complex bureaucratization. People begin to hold the belief that big is better as well as more efficient and cheaper. The workings of the profit motive become more evident. People complain about their neighbors chasing the almighty dollar, or increasing prices to whatever the market will bear. People begin to rely on institutions more. Problems that used to be solved at the family level are now brought to social workers for solution. At the same time, residents become more demanding of institutions. In areas where the lack of medical care had always been a fact, residents are now demanding such care.

The nature of social life is such that people, institutions, and culture are all intricately bound up with one another, are a system, and when one component changes, other components must change as well. Among long time residents the cultural and social changes take their toll. In some cases these responses are pathological; in Rock Springs, for example, the mental health clinic shows an eightfold increase in caseload over 5 years ago, and its director says much of that increase is from long time residents. Among long time residents, at least four ways of responding to the changes in their communities have been observed.

Make The Change. For the largest number of people, taking the changes in stride has been the response. The overworked social worker accepts the larger caseload and works harder. The police chief starts keeping better records, sends his employees to in-service training, and in general updates the department. The shopowner realizes that he/she should remodel the shop if he/she wishes to attract the expanded market. The long time resident goes next door and welcomes the newcomer to the community.

Maintain The Status Quo. Some impact community residents seem to be taking the approach of doing things as they always have, while also mourning the passing of a way of life (which may or may not have been romanticized). If these people are in business, they have not expanded or remodeled, if in government, they have not held more meetings or hired more staff. Such persons are the ones most likely to find themselves relieved of their roles by newcomers or other people more willing to make adjustments to the new demands.

Deny The Changes. Though this is increasingly hard to do, some continue to pretend that nothing is happening. Perhaps they fear they cannot make the changes, or perhaps they simply refuse to, or perhaps they feel things will blow over and return to normal.

Leave The Situation. Flight has always been one of the options persons have open to them in uncomfortable situations. Flight from the bad situation can take the form of leaving the role that is changing (e.g., sell the store, resign from public office), or it can take a more extreme form of leaving the community entirely.

For newcomers, the reaction to living in a boom town is based, not on what the town used to be before the boom, but what the town they came from was like. Their reactions are also based on their reasons for moving to the new community. For example, a family fleeing the pace of a big city to the small town life may be extremely happy; they may be nearly oblivious to the urbanization of the town and may see any lack of facilities or goods as a minor inconvenience more than compensated for by cleanliness, neighborliness, and space. Another family moving from a big city only because the company transferred them may hate the town and may feel the lack of goods and services to be a constant irritant. Finding themselves strangers in a place where large

numbers of people know each other may increase their feelings of loneliness. Those who move to towns as large as Rawlins from smaller towns may find the pace too fast, the culture too urban.

While long time residents who are unhappy blame the boom (or occasionally the newcomers or some "element"among the newcomers), the newcomers blame the town itself. Thus, those newcomers who are unhappy tend to isolate themselves from the town, from its organizations, groups, politics, etc. This is particularly easy since the newcomers have other newcomers with whom to socialize. The extreme of this behavior can be seen in those newcomers who know they will be leaving soon, and who socialize almost exclusively with others who work for their company, who will also leave soon. Newcomers who like the town are much more likely to cross the old/new barrier and participate in the social life of the community.

Change in the physical environment also has affected lifestyles in the region. One change perceived almost universally is an increase in noise, which to many small town residents must certainly symbolize the shift from a small town way of life toward the way of life that characterizes big cities. The overcrowding that some respondents noticed probably means to them the same thing. In places where physical growth has been most extensive, the pattern has been unmistakably suburban; that is the physical appearance and ambience of the new areas are not western or small town. The new areas look like new areas in the surrounding suburbs of any big city: strip commercial developments, car orientation (e.g., large parking lots, many drive-in facilities), tract homes, chain stores, and residential areas with cul-de-sacs and curving lanes. Thus as the culture of the communities changes from that of small town to that of mass society, the physical appearance of the towns undergoes the same change, starting to resemble, if not urban areas, at least suburban ones.

FUTURE ENVIRONMENT

The most visible changes in the region by 1990 will probably be due to increased population. The continued operation of existing coal mines and additional development of oil, gas, uranium, and construction projects (e.g. new state penitentiary) will offer increased employment opportunities and cause an increase in the region's population.

It is estimated that regional employment will increase by 72% from 1977 to 1990. This would be an increase from 1,415 jobs in 1977 to 2,429 in 1990 (Centaur 1978). Personal income will increase 153% from the estimated 1977 figure of $147.1 million to $372.3 million in 1990. The region's population will increase 64% from an estimated 18,484 persons in 1977 to 30,311 in 1990. Approximately 80% (9,459) of the growth would occur in Rawlins (Centaur 1978).

Increases in population will place additional demands upon private and public services. Without significant advances in planning and construction, housing shortages will continue to be a regional problem. Inflated prices will also be a burden upon residents until services catch up with demand.

All recreation activities are anticipated to increase as the population increases throughout the region (see Table R2-35). This increased recreational use will cause a degradation in the outdoor recreational experience which now exists throughout the region. There will be a need to construct new facilities and upgrade the existing facilities both urban and rural.

Trails, such as the Oregon Trail and the Overland Stage route, will continue to deteriorate as recreational use and natural forces act to obliterate vestiges of wheel-ruts.

Many of the historic sites within the ES region are deteriorating, and only a few have been restored. Although deterioration from antiquities collectors and natural causes will continue in most sites, some actual preservation and restoration will take place.

The hydraulic regime of the region including aquifer systems, streamflow, and water quality will remain basically unchanged by future development, but municipal use will increase due to development of other mineral resources and natural growth of the region (Figure R2-25). Industrial use may increase by a few hundred acre feet per year (ac ft/yr). The city of Cheyenne plans to increase its diversion to about 34,000 ac ft by the mid 1980s with water from Little Snake River Basin. The Savery-Pot Hook project, which has an uncertain future, would increase irrigation use from the Little Snake River by 44,000 ac ft/yr.

Mineral production in the ES region for the periods of 1980, 1985, and 1990 would be as follows: coal—13.1, 13.6, and 11.8 million tons per year; and oil and gas—298, 353, and 408 total wells. Uranium production is unquantifiable.

By 1990, other changes in these resources would result from oil and gas uranium, sand and gravel development, and construction of the Savery-Pot Hook project. Oil and gas, uranium, and sand and gravel development would have resulted in alteration on the following cumulative acreage: 680 acres by 1980; 1,571 by 1985; and 1,881 by 1990. Most of this change would be in the western half of the ES region.

The development of the Savery-Pot Hook project would have resulted in the alteration of 605 acres of soils and vegetation by 1990 with the reservoir and dam and the construction of canals and laterals. Vegetative changes and some soil alteration would be noticeable on 17,280 acres of land that would receive either full service or supplemental irrigation.

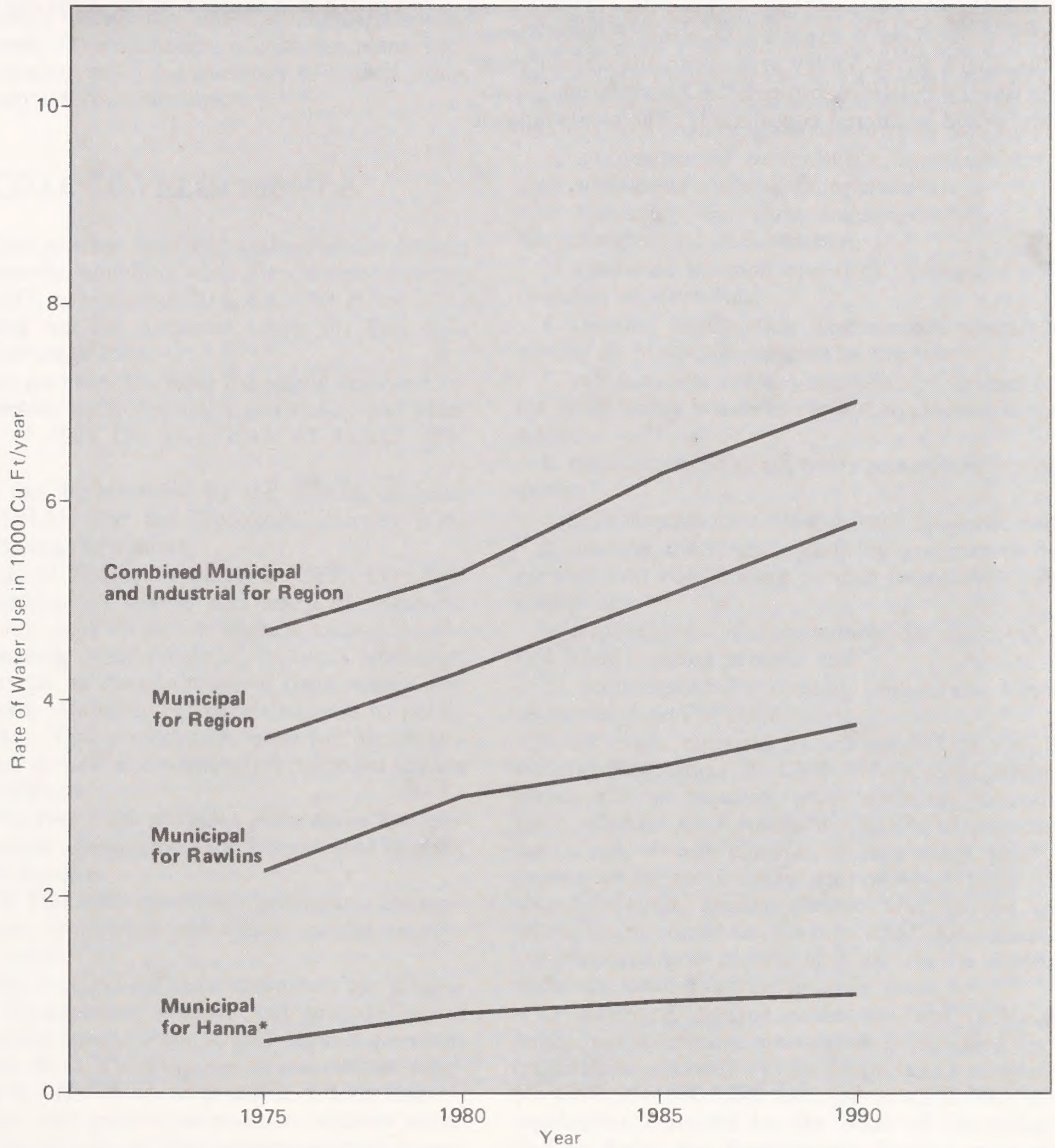
In summary, by 1990 the vegetative and soil resources would be changed on 12,856 acres.

Total acres of wildlife habitat lost to all energy related activities in the region would total 12,856 acres by 1990 (existing mines—10,370 acres; other—2,486 acres). Major habitat types that would have been destroyed by all of these activities include; sagebrush (9,965 acres), birdfoot sagewort (2,200 acres), and mountain shrub (302 acres). The remaining 389 acres are compared to minor types.

Table R2-35

RESIDENT VISITOR USE ESTIMATES

Activity	1977 Population 18,484	1980 Population 22,201	1985 Population 32,506	1990 Population 37,865
Fishing	76,893	93,670	114,892	132,762
General	98,705	102,339	149,917	175,197
Hunting (Big Game)	28,476	28,872	34,494	39,405
ORV	2,957	3,526	4,245	4,849
Urban	46,949	60,169	78,806	94,874
Water Sports	35,489	44,300	56,518	66,987
Winter Sports	9,427	12,343	16,982	20,611



*Same Line Applies for Saratoga

Figure R2-25

PREDICTED WATER USE WITH NO ADDITIONAL MINES

The grazing of livestock is expected to continue to be the primary use of the range land of the ES area. The number of ranch operations is expected to decrease through ranch consolidations as it has in the past. The grazing level is expected to remain stable since the grazing lost to mining activities would be replaced by the grazing afforded on restored mined lands that are returned to production, and losses to other activities would be minimal.

Farm production is expected to remain stable except for the Snake River Valley area. With the development of the Savery-Pot Hook project, the future farming community would be altered considerably. The availability of irrigation water would result in an increase of 8,000 head of cattle and 12,000 head of sheep. Crop production would increase by 28,189 tons of alfalfa; 4,048 tons of native hay; 92,300 animal unit months (AUMs) of grazing; and 302,950 bushels of grain (Bureau of Reclamation 1976).

A detailed analyses of the regional air quality impact of future developments without the proposed actions is presented in Chapter 8 of the Regional ES.

CHAPTER 3

PLANNING AND ENVIRONMENTAL CONTROLS

This chapter describes the planning and environmental controls which regulate coal development.

This chapter is in three parts: (1) a list of legislation and regulations which constrain federal, state, and/or local governments when they consider authorization of coal development; (2) a discussion of land use plans, controls, and constraints; and (3) a summary of federal, state, and local agency interrelationships.

COAL DEVELOPMENT

Two laws that provide the basic authorities for leasing the federal minerals, including coal, are: Mineral Leasing Act (41 Stat. 437, as amended; 30 U.S.C. 181 et seq.) and Mineral Leasing Act for Acquired Lands (61 Stat. 913; 30 U.S.C. 351 through 359).

The law that provides the basis for public land and resource management is the Federal Land Policy and Management Act of 1976 (90 Stat. 2743; 43 U.S.C. 1701 through 1771).

These laws are implemented by the Bureau of Land Management (BLM) and the Geological Survey (GS) under the following regulations:

Title 43 Code of Federal Regulation (CFR) Part 3041 provides procedures to ensure that adequate measures are taken during exploration or surface mining of the federal coal (among other minerals) to avoid, minimize, or correct damages to the environment (land, water, and air) and to avoid, minimize, or correct hazards to public health and safety. This provides the basis for the technical examination, as well as evaluation of proposed mining and reclamation plans.

Title 43 CFR Part 3500 provides procedures for leasing and subsequent management of federal coal (among other minerals) deposits.

Title 43 CFR Part 2800 establishes procedures for issuing rights-of-way to private individuals and/or companies on public lands.

Title 30 CFR Part 211 governs operations for discovery, testing, development, mining, and preparation of federal coal under leases, licenses, and permits pursuant to 43 CFR Part 3500. The purposes of the current regulations in Part 211 (5/76) are to promote orderly and efficient operations and production practices without waste or avoidable loss of coal or other mineral-bearing formation; to encourage maximum recovery and use of coal resources; to promote operating practices which will avoid, minimize, or correct damage to the environment, including land, water, and air, and avoid, minimize, or correct hazards to public health and safety; and to obtain a proper record of all coal produced.

Surface Mining Control and Reclamation Act of 1977 regulates the surface mining of all coal deposits and is implemented by the Office of Surface Mining under the regulations in Title 30 CFR Part 700. Many of these regulations are similar to the 43 CFR 3041 and 30 CFR 211 regulations which regulate coal development on public lands. The Act and regulations provide for:

1. environmental performance standards for surface coal mining and reclamation operations;
2. inspection and enforcement procedures, including the assessment of civil penalties;
3. assistance to small operators in meeting permit application requirements;
4. develop reclamation performance standards to be met by all programs required by the law;
5. requirements for development of federal programs for those states which chose not to develop a state program;
6. requirements and approval procedures for state programs;
7. requirements for a federal lands program; and
8. develop the initial regulatory program to be incorporated into coal mining permits issued under state and federal law;
9. requirements and procedures for approval of state and federal mining permits; and
10. requirements for posting, release, and forfeiture of reclamation performance bonds.

In all cases, pursuant to Section 515 of SMCRA and Federal Regulation 30 CFR 715.13, coal mining operations will be required, as a minimum, to restore the lands affected to a condition capable of supporting the use which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. Mining permits will not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the mining and reclamation plan.

In summary, surface protection and reclamation of lands, mined for coal production, is provided by various regulations enforced by the Department of the Interior (43 CFR 3041, 30 CFR 211, and 30 CFR 700), as well as regulations enforced by the State of Wyoming (Land Quality Rules and Regulations). Surface protection and reclamation provisions are further covered under a cooperative agreement between the State of Wyoming and the Department of the Interior. The agreement provides for cooperation in review and approval of mining and

reclamation plans, as well as cooperation in monitoring and enforcing reclamation standards.

Fish and Wildlife Acts

Applicable authorities include the Bald Eagle Protection Act of 1969 (16 U.S.C. 668 through 668c). Under this law mining operations will not be permitted in any area where such activities would molest or disturb bald and/or golden eagles and/or their nests.

The Fish and Wildlife Coordination Act of 1958 requires consultation with the U.S. Fish and Wildlife Service whenever the waters of any stream or other body of water are to be altered for any purpose. The consultation process is to provide for conservation of fish and wildlife resources by promoting effective planning and cooperation between governmental agencies (16 ESC 622(a).

Endangered Species

Applicable authorities include the Endangered Species Act of 1973 (87 Stat. 844). This Act provides protection for listed species (both flora and fauna) and their critical habitat. Prior to authorization of any disturbance of lands under lease or permit, the surface managing agency will require that a survey be made to determine if listed species or their habitat may be present. If it is determined that listed species or their habitat may be present and could be affected by the proposed activities, appropriate consultation with FWS will be required. No activities will be authorized until consultation is completed as per 50 CFR 402 (January 4, 1978).

Floodplains Management

Executive Order 11988, 24 May 1977, directs federal agencies to take appropriate actions to avoid, to the extent possible, long and short-term adverse impacts associated with the occupancy and modification of floodplains. The executive order further states that federal agencies will avoid direct or indirect support of floodplain development wherever there is a practicable alternative.

Protection of Wetlands

Executive Order 11990, 24 May 1977, directs federal agencies to take appropriate actions to avoid, to the extent possible long and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

Paleontology

Paleontological resources are protected under authorities contained in the Federal Land Policy and Management Act of 1976 (FPLMA).

Cultural Resources

Applicable authorities include:

1. Antiquities Act of 1906 (34 Stat. 225; 16 U.S.C. 431 through 433);
2. Historic Site Act of 1935 (49 Stat. 666);
3. Historic Preservation Act of 1966 (80 Stat. 915; 16 U.S.C. 470);
4. National Environmental Policy Act of 1969 (33 Stat. 852; 42 U.S.C. 4321, et seq.);
5. Executive Order 11593;
6. Federal Lands Policy and Management Act of 1976 (90 Stat. 2743); and
7. state laws as appropriate.

Both federal and state antiquities acts regulate antiquities excavation and collections, and both protect historical values on public lands. They provide for fines and/or imprisonment for violators of their provisions. The Historic Preservation Act requires that certain federal undertakings be submitted for review by the National Advisory Council on Historic Preservation. Executive Order 11593 requires all federal agencies to cooperate with the nonfederal agencies, groups, and individuals to insure that federal plans and programs contribute to the preservation and enhancement of nonfederally owned historic and cultural values.

No mining or rights-of-way will be approved until the BLM has coordinated professional cultural resource (cultural resources include archeological, architectural, and historical remains) surveys with the Wyoming State Historic Preservation Officer and received his written comments and review. Additional surveys and mitigation may be necessary if surface evidence indicates further evaluation is necessary.

In a memorandum dated July 7, 1977, the BLM and GS have developed "Cooperative procedures pertaining to the protection of cultural resources related to onshore mineral leasing operations exclusive of oil, gas, geothermal, and oil shale". These procedures have been implemented for all proposed actions in southcentral Wyoming.

Air Quality

Applicable legislation and regulations relating to air quality include:

1. Clean Air Act of 1970;
2. National Ambient Air Quality Standards (NAAQS);
3. New Source Performance Standards (NSPS);
4. Wyoming Environmental Quality Act of 1973;
5. Wyoming Ambient Air Quality Regulations;
6. Clean Air Act, as amended in 1977; and

7. The Prevention of Significant Air Quality Deterioration Regulations of 1978.

The 1970 Clean Air Act Amendments establish primary and secondary national ambient air quality standards (NAAQS) for six pollutants: total suspended particulates (TSP), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide, photochemical oxidants (ozone), and hydrocarbons. These standards are shown in Table R3-1. The primary standards were set to protect the public health, while the secondary standards were set to protect the public welfare.

The Wyoming ambient air quality standards are identical to the most stringent national standard except for the annual 24-hour sulfur dioxide standards. Wyoming's 60 microgram per cubic meter ($\mu g/m^3$) annual and 260 $\mu g/m^3$ 24-hour standards are more stringent than the 80 $\mu g/m^3$ annual and 365 $\mu g/m^3$ 24-hour national ambient air quality standards (Table R3-1).

The southcentral Wyoming ES region, Carbon and Sweetwater Counties, is attaining the national standards for all "criteria"pollutants (U.S. Environmental Protection Agency 1978). All of the Wyoming air quality standards are also being met. The prevention of significant air quality deterioration regulations apply to all areas attaining the national ambient air quality standards. The 1977 Amendments to the Clean Air Act established "maximum allowable increases"which limit future increases of ambient concentrations of TSP and sulfur dioxide above baseline concentrations. Ambient concentrations in calendar year 1974 are nominally the baseline concentrations. The "maximum allowable increases"(or increments) were established for three class areas as a function of the allowable rise in ambient TSP and SO_2 concentrations. All "major"stationary source emissions contribute to the consumption of the increments shown in Table R3-1. The baseline concentration plus the increment cannot exceed the applicable national ambient air quality standard.

Under the 1977 Amendments all areas of the country were designated as Class II except for "mandatory"Class I areas. No mandatory Class I areas are within the southcentral Wyoming ES region (see Map R2-4). Class II areas can be reclassified by the state; however, mandatory Class I areas cannot be reclassified.

The specific regulations needed to fulfill the PSD requirements of the 1977 Amendments were promulgated on June 19, 1978. In 43 CFR 118, the EPA decided to exclude from any air quality impact assessment of a source, any fugitive dust that would emanate from it. Fugitive dust is defined as particles of native soil which are uncontaminated by pollutants resulting from industrial activity.

The EPA has indicated that each operator will have to employ the best management practice for fugitive dust regardless of the predicted concentrations during operations. Thus, each mining plan and the Department's approval thereof will stipulate an appropriate combination of the following fugitive dust controls.

1. Pavement or equivalent stabilization of all haul roads used or in place for more than 1 year.
2. Treatment with semi-permanent dust supressants of all haul roads used or in place for less than 1 year and for more than 2 months.
3. Watering of all other roads in advance of and during use whenever sufficient unstabilized material is present to cause excessive fugitive dust.
4. Reduction of fugitive dust at all coal dump (truck to crusher) locations through use of negative pressure bag house or equivalent methods. Inclusion of conveyor and transfer point covering, and spraying, and the use of coal load out silos.

All mining operations which have the potential to emit more than 250 tons/year of uncontrolled particulates will be required to apply for PSD permits.

Water Quality

Applicable legislation and regulations include:

1. Federal Water Pollution Control Act (FWPCA), as amended in 1972;
2. Wyoming Environmental Quality Act of 1973; and
3. Water Quality Standards for Wyoming, Wyoming Department of Health and Social Services, June 28, 1973.

National standards to restore and maintain the chemical, physical, and biological integrity of the nation's waters were promulgated by the FWPCA as amended in 1972.

Wyoming water quality standards were issued in accordance with the Wyoming Environmental Quality Act of 1973. Under Article 3 of the Act, DEQ's Water Quality Division is empowered to enforce these water quality standards. Important prescribed standards include those which specify maximum short-term and long-term concentrations of pollution, minimum permissible concentrations of dissolved oxygen and other matter, and the permissible temperatures of the waters of the state. Effluent standards and limitations specifying the maximum amounts of pollutions and waste which may be discharged into state waters are described. Other health and water quality standards pursuant to Section 402(b) of the FWPCA are also described.

Water quality planning required by Section 208 of the FWPCA is in progress in the region. Wyoming has identified Sweetwater County as falling within a "designated area"having priority planning needs for identification of management practices necessary to maintain or improve water quality. A major emphasis is nonpoint source pollution resulting from surface disturbance such as mining. As a "designated area,"Sweetwater County is included in a recently completed draft water quality plan prepared by a special planning agency, Southwestern Wyoming Water Quality Planning Association, with consultation with EPA.

Carbon County falls into the category of an "undesignated area"(one of twelve such counties in Wyoming). DEQ has contracted the preparation of a water quality plan for Carbon County with the Wyoming Conservation Commission. A final plan will be printed soon.

Table R3-1

FEDERAL AND WYOMING AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Federal Primary Standards* $\mu g/m^3$	Federal Primary Standards* ppm	Federal Secondary Standards* $\mu g/m^3$	Federal Secondary Standards* ppm	Wyoming State Standards** $\mu g/m^3$	Wyoming State Standards** ppm
Sulfur Dioxide	Annual (Arithmetic)	80	.03			60	.02
	24-hour	365	.14			260	.10
	3-hour			1,300	.5	1,300	.5
Total Suspended Particulate	Annual (Geometric)	75		60		60	
	24-hour	260		150		150	
Carbon Monoxide	8-hour	10,000	9	10,000	9	10,000	9
	1-hour	40,000	35	40,000	35	40,000	35
Photochemical Oxidant	1-hour	160	.08	160	.08	160	.08
Non-Methane Hydrocarbons***	3-hour (6-9 a.m.)	160	.24	160	.24	160	.24
Nitrogen Dioxide	Annual	100	.05	100	.05	100	.05

*Title 40 CFR Part 50 National Ambient Air Quality Standards (Standards for averaging times of less than one year are not to be exceeded more than once a year).

**Wyoming Ambient Air Quality Regulations, as amended in 1975 (Standards for averaging times of less than one year are not to be exceeded more than once a year).

***Standards set as a guide to achieve to Photochemical Oxidant Standards.

The State of Wyoming is responsible for setting water quality standards and developing all "208 plans"; however, EPA plays a monitoring and arbitration role in the process.

Water Impoundments

Requests for water impoundments covering public lands in areas of important cultural values and recreation impacts can be granted, pending decisions by the State Engineer, through the authority contained in the Reservoir Salvage Act of 1960 (74 Stat. 220) and the National Environmental Policy Act of 1969 (83 Stat. 852, 42 U.S.C. 4321 et seq.). SMCRA requires that before an impoundment (for example, a stockwater pond) can be approved as part of a mining and reclamation plan, it must be demonstrated that precipitation, runoff and/or groundwater inflow are of the quality and quantity to be suitable and sufficient for stock use and that the impoundment will contain water. The operator must follow the Wyoming Environmental Quality Act and the rules and regulations of the Wyoming Department of Environmental Quality dealing with impoundments in the Land Quality Rules and Regulations dated 1975, Chapter 3, Impoundments.

If a planned reservoir covers public land surface or mineral estate and its water is designated for another federally approved project, it will first be assessed under the requirements of the National Environnmental Policy Act and salvage requirements under the Reservoir Salvage Act. If cultural values are located the "criteria for effect"under Section 106 of the National Historic Preservation Act and Section 2(b) of E.O. 11593 will be initiated by any federal agency joined in the project.

Solid Waste Disposal

Applicable regulations include the Wyoming Solid Waste Management Rules and Regulations, 1975, that provide for solid waste disposal plans to be submitted to the state by every person or municipality proposing such plans.

The Resource Conservation and Recovery Act of 1976 (Solid Waste Disposal), P.L. 94-580, (90 Stat. 2795) provides a method for technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials and for the safe disposal of discarded materials and to regulate the management of hazardous waste.

Mineral Protection

Oil and gas leases are in effect for much of the area. Priorities for mining or drilling for oil and gas on public lands are established by the Conservation Division of the Geological Survey. Mining operations approaching wells or bore holes that may liberate oil, gas, water, or other fluid substances must be approved in accordance with 30 CFR 211.17 and 30 CFR 211.63. Impacts on oil and gas areas can be mitigated largely by agreements among operators where significant impact on oil well siting or pipeline location arises. In extreme instances of conflict, technology is adequate through directional drilling, drainage practice, recovery of wells lost, pipeline and flow line relocation, pillar recovery, and mining methods to adequately mitigate impacts which might arise.

Land Quality

Applicable regulations include the Wyoming Land Quality Rules and Regulations, 1975, SMCRA, FLPMA, and the proposed cooperative agreement between the Department of Interior and the State of Wyoming under Section 523(c) of SMCRA P.L. 95-87 which will provide procedures for approval of a mining permit and license to mine which are necessary requirements for mining operations.

Railroads

The Interstate Commerce Act (49 Stat. 543, 49 U.S.C. 1(18) requires prior approval from the Interstate Commerce Commission for the extension or new construction of a line of railroad or the abandonment of operation of a line of railroad. Exempted from this authority are spur, industrial team, switching, or side tracks located wholly within one state. Commission certification is based on a balancing of the relevant economic, technical, and environmental factors.

State Highways

The Wyoming State Highway Department requires prior approval for relocation or crossing of a state highway.

Carbon County requires approval for development to occur within the scenic corridor along designated roads. Approval is also required for construction of permanent structures or buildings throughout the county.

Industrial Siting

The Industrial Development Information and Siting Act of 1975 requires a siting permit for industrial development— which exceeds 50 million dollars in cost. The Wyoming Industrial Siting Administration has responsibility for the issuance of siting permits.

Provisions For Revenue Sharing and Taxation

Joint Powers Act

Cities and counties share revenues, facilities, and services.

Local Sales Tax

Cities and counties have the option to impose a 1% sales tax. This option has been exercised in Carbon County.

Coal Impact Tax

The state has the option to tax mining companies to furnish a source of revenue to be spent for roads, streets, highways, water, and sewer projects. Limited funds accrued from the coal impact tax may be borrowed to upgrade certain public facilities.

Mineral Leasing Royalties

The state receives 50% of the mineral royalties from any mineral leasing projects. A 7.05% share of these funds (3.75% of the total lease royalties) goes to municipalities, and a 2.25% share goes to counties. Other distributions include state highway work in counties affected by resource development (2.25%), the school foundation program (37.50%), the state highway fund (26.25%), capital outlays for higher education (6.75%), and public schools capital construction (4%).

Severance Taxes

The state receives from operating coal companies 8.50% of the value of gross products extracted from mines. This 8.50% is allocated for the state general fund (2%), the permanent trust fund (2.50%), the water development account (1.50%), a capital facilities and roads fund (1.5%), and the state highway fund (1%).

Ad Valorem Revenues

Property taxes of 6.0 mills are presently collected in Carbon County for the state school equalization fund. The equalization levy is determined annually by the state and can vary from 0 to 6 mills.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

Federal

In the region of analysis, a large number of separate jurisdictional entities exercise certain types of land and resource use controls. The federal sector includes the Forest Service (FS) (Medicine Bow National Forest) and Bureau of Land Management (BLM) (public lands and mineral estate under certain private lands). The Bureau of Reclamation has small holdings within Carbon County.

Development, management, use, and control of use on public lands has been principally delegated to FS and BLM. Controls are effected through issuance or nonissuance of a variety of leases, permits, licenses, etc. Each authorization to use public lands contains provisions to control that use. Controls exercised by the federal government for the subsurface estate are governed by the statutes authorizing the disposition and use of that estate. Foremost among the statutes is the authority for leasing coal deposits and authority to require as a condition of such leases, an operation-management plan and a reclamation-restoration plan. Management policy has been extended in greater detail by the National Environmental Policy Act of 1969, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. In certain situations, there is a joint or multiagency sharing or particular management and control functions and responsibilities, such as the cooperative agreement between the Department of the Interior and the State of Wyoming that allows the state to administer and enforce reclamation operations on federal leases in Wyoming. The subsurface estate vested in private or state ownership would normally be governed by applicable State of Wyoming statutes.

State

The Wyoming Commissioner of Public Lands is responsible for the administration, leasing, and management of lands owned by the State of Wyoming. Under State of Wyoming statutes, the state is authorized to perform and administer certain surface land use, planning, and development activities on state, county, municipal, and privately-owned properties. Two pieces of legislation passed by the 1975 Wyoming Legislature which could have a significant effect on land use are the Wyoming State Land Use Planning Act and the Industrial Development Information and Siting Act. The Land Use Planning Act requires completion of county land use plans by 1978, and these plans could conflict with or modify some of the energy development proposals. Carbon County has completed its comprehensive plan, and Sweetwater County is updating various parts of an earlier plan. Both counties have full time planners.

The Industrial Siting Act requires a prospective industry to furnish plans for alleviating socioeconomic impacts and other extensive information before a state permit is granted for construction of certain facilities. This act applies to major developments costing 50 million dollars or more in 1975 dollars, such as gasification or electric generation proposals. The first two projects to be sited under this act were the Jim Bridger Power Plant (Sweetwater County) and the Missouri Basin Power Plant near Wheatland, Wyoming.

The State of Wyoming retains jurisdiction over state lands. Some of these lands were conveyed to the state as part of the act admitting Wyoming to the Union. This

legislation granted Sections 16 and 36 of every township to the state for educational purposes. Use and control of these lands (including mineral leasing, rights-of-way, etc.) are governed by Wyoming law.

County and Municipal

Under Wyoming statutes, counties have authority to affect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes.

Less than 1% of the lands in the region are owned by county governments. Use and control of these lands are governed by state law and county ordinances. The county cannot effect planning or zoning control over any lands used in the extraction or production of mineral resources unless reasonably necessary to protect the health and safety of its citizens. Control over mineral uses on these lands is vested in the State of Wyoming under the Wyoming Environmental Quality Act of 1973. This act also authorizes the state to control air quality, water quality, and solid waste management.

Municipalities have authority to effect a master plan, zoning, and other regulatory controls. They do not have statutory authority to effect controls over mineral extraction or production within their corporate limits. Furthermore, the Wyoming Environmental Quality Act of 1973 would preempt cities' authority to regulate and control air, water, solid waste, and land quality standards except where specifically delegated to a municipality.

Where a county or city lacks a specific authority, provisions of the Wyoming Joint Powers Act are available to enable joint exercise of power, privilege, or authority. This legislation enables two or more agencies to jointly plan, create, finance, and operate (control) water, sewage, or solid waste facilities; fire protection agency facilities; transportation systems facilities; and public school facilities.

Land Use Plans

Land use planning for the area in which a checkerboard land ownership pattern exists, extending approximately 20 miles on each side of the Union Pacific Railroad main line, is of considerable importance in southcentral Wyoming. Alternating sections are in private (primarily Rocky Mountain Energy Company) or governmental (federal or state) ownership. Successful implementation of any land use plans must involve cooperation between the owners in this area. The majority of coal development interests in southcentral Wyoming are within this checkerboard pattern of ownership. Rocky Mountain Energy has retained ownership of the surface and minerals within the checkerboard and has leased grazing privileges to local ranchers and other interests. They have entered into joint ventures with other companies to develop their minerals (coal) along with federal coal. Some surface has been sold to communities and private individuals adjacent to the railroad for housing and other municipal purposes.

BLM Planning

The Overland and Hanna Management Framework Plans (MFPs) were published in 1977. The MFPs are designed to serve as a guide for multiple-use management and development of the surface of public lands as well as the federal mineral estate, much of which lies under privately owned surface. The MFP areas correspond generally with the ES region. Proposals for coal development and lands of possible interest to the mining industry for potential coal development were addressed in BLM's land use planning process. An important aspect of the process included consultation with representatives of state government and local governments. Also comments and suggestions received through numerous public meetings influenced the content of the MFPs.

Potential socioeconomic impacts which could result from coal development are a major concern in the region. Some local and state government planners and many citizens have recommended a "go slow"approach when considering possible future coal development in the region. Since other interests have recommended unlimited development, the 1977 MFPs attempted to strike a balance between the various recommendations and consider possible development. Recommendations and decisions of the MFPs relating to coal are as follows:

1. To manage mineral resources for efficient development, giving priority consideration to energy minerals but, at the same time, providing environmental protection and consideration of socioeconomic impacts.
2. To designate areas of potential interest for coal development which are compatible for mining under the multiple-use concept of management and which contain uncommitted and economic coal reserves.
3. Pending the results of the current regional analysis, the approvals of the proposed mining and reclamation plans (Seminoe I, Hanna South, and Cherokee) would be in accordance with multiple use objectives of the MFPs.
4. Future proposed actions in support of coal mining proposals (e.g., rights-of-way) would require an analysis of possible impacts. If compatible with other uses of the area and accompanied by necessary environmental stipulations, such actions would serve the multiple-use objectives of the MFPs.

Any future planning surrounding the possibilities of lease phasing, scheduling, or exchange (not addressed in MFPs) could be accomplished only through full involvement of state and local governments' assistance and recommendations.

Forest Service (FS) Planning

A portion of Medicine Bow National Forest is included within the region. A multiple use plan (MUP) cover-

ing this area was updated in December 1971. FS and BLM personnel met during BLM's MFP land use planning process in order to coordinate and prioritize possible future leasing areas within the forest.

Local Planning

In 1976, the Carbon County Council of Governments was formed to serve as the technical planning arm of the Carbon County Planning Commission. The Council provides planning assistance to all incorporated portions of the county and to unincorporated areas upon request. A final county comprehensive plan has been published.

INSTITUTIONAL RELATIONSHIPS

Federal

Office of Surface Mining (OSM)

OSM, in consultation with surface managing agency (BLM), GS, and the state regulatory authority, where applicable, recommends approval or denial of surface coal mining permit applications to the Assistant Secretary of Energy and Minerals (mining permit application includes the mining and reclamation plan). OSM is the federal regulatory authority responsible for, as lead agency, reviewing coal mining and reclamation plans (permit application); enforcement of all environmental protection and reclamation standards included in an approved mining permit; the monitoring of both on and off-site effects of the mining operation; and abandonment operations within the area of operation of a federal lease.

OSM is the principal contact for all coal mining activities within the area of operation. OSM will conduct as many inspections as are deemed necessary, but no less than one partial inspection quarterly and at least one complete inspection every 6 months (30 CFR 721.11(c)).

OSM, after consultation with BLM, GS, and the operator establishes the boundaries of the permit area for the proposed mine and approves the locations of all the mine facilities located within this boundary.

Section 523 of SMCRA requires the federal lands program to adopt those state performance standards which the Secretary determines are more stringent than the federal standsrds. (The federal lands program means the program established by the Secretary pursuant to Section 523, SMCRA to regulate surface coal mining and reclamation operations on federal lands.) Therefore, the performance standards enforced by OSM on a federal leasehold should be at least as stringent as those required under state law or regulations. The Department of the Interior is negotiating a cooperative agreement pursuant to Section 523(c) of SMCRA with the state of Wyoming and other states. Whenever this agreement is consummated with the state, the OSM's functions and responsibilities specified in this agreement will be delegated to the state regulatory authority. Under this agreement, OSM and state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to the officials authorized to take final action on the application. The Secretary is prohibited by law from delegating his authority to approve mining plans on federal lands.

Bureau of Land Management (BLM)

The BLM, after consultation with OSM, GS, the public, and the governor may offer for competitive lease, tracts of lands found potentially valuable for development of the coal resource during the land use planning process. The BLM formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources other than coal and the post mining land use of affected lands.

The BLM, after consultation with GS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs proposed on federal lands by a mining company outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (P.L. 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and GS subject to standard requirements for duration of the grant, right-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are found in 43 CFR 2800, the land use plan, and from an on-the-ground evaluation. The right-of-way applications listed in Chapter 1 are fully evaluated in the specific volumes of this statement for each mine site. The BLM is the lead agency, in coordination with GS and OSM, for all proposed uses other than coal mining on federal lands within a leasehold.

Geological Survey (GS)

The Geological Survey is responsible for reviewing mining plans for development, production, and coal resource recovery requirements on a federal leasehold. GS is responsible for the maximum economic recovery of the federal coal resource and that the federal government receives fair market value for the coal resource.

Legal Requirements

The relationship and special requirements of the Federal Land Policy and Management Act (FLPMA), Federal Coal Leasing Amendments Act (FCLAA), and the Surface Mining Control and Reclamation Act (SMCRA) are discussed below.

Section 523 of SMCRA requires that a federal lands program which includes the requirements of this act be promulgated and implemented no later than August 3, 1978. Until the federal lands program is implemented, the initial regulations as required in section 502 of SMCRA and published in final form (30 CFR 715 and 716) in the December 13, 1977 *Federal* Register will apply, as modified to all federal coal leases. These regulations will be

modified under the authority of section 523(c) and 702(b) of this act to meet the requirements of the Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. 1701-1771). The basic changes in the regulations are: (1) post mining land use as determined in the surface managing agency's comprehensive land use plan; (2) permanent roads, dams, power lines, etc., to be constructed on public lands will, at a minimum, meet the design standards of the surface managing agency, and (3) resource data collected in the process of developing the land use plan or lease stipulations will be available for use in developing the reclamation plan.

FCLAA requires that a comprehensive land use plan must be completed prior to lease issuance and that the proposed lease must be compatable with the plan. This act lists specific areas which must be classified as unsuitable for surface mining.

FLPMA requires a comprehensive land use plan with consideration for present uses as well as future use of the lands. Land uses on adjacent lands must also be considered prior to determination of the post mining land use. FLPMA requires consideration for all resources and land uses in the determination of land use allocations. The following is a discussion of the relationship between specific requirements of the three laws and the proposed actions. The course of action described in the specific sections below will serve as mitigatory measures.

Surface Owner Consent. Pursuant to Section 714 of SMCRA, where coal owned by the United States falls under private surface, the Secretary of the Interior shall not enter into any lease until the surface owner has given written consent to enter and commence a surface mining operation.

Alluvial Valley Floors West of the 100th Meridian. The following are some of the data used in the determination of alluvial valley floors; geomorphology, soils, hydrology, flood or subirrigation, vegetation and land uses. Soil surveys are required to inventory lands classified as prime farmland and as potential alluvial valley floors. Mining and reclamation plans which propose to conduct a surface coal mining operation on or adjacent to alluvial valley floors shall include baseline data and surveys as prescribed in 30 CFR 715.17(j)(3) to establish standards which insure the preservation of the hydrologic function of these alluvial valley floors.

Prime Farmland. Prior to approval to mine on lands classified as prime farmlands, the operator will have to provide data to demonstrate that his proposed method of reclamation will achieve, within a reasonable time, equivalent or higher levels of yield after mining as existed before mining. If approved, special soils handling and storage stipulations will be included in the mining plan.

Lands Classified as Unsuitable for Surface Coal Mining. Lands proposed for surface mining, as well as lands included in petition applications requesting the designation of coal lands as unsuitable for surface coal mining will be processed through the surface managing agency's land use planning and public involvement procedures. Petition applications should be filed with the Office of Surface Mining. Prior to designating lands unsuitable for mining the surface managing agency will consult with the appropriate state and local agencies and also shall prepare a statement on: (1) the potential coal resources of the area; (2) the demand for the coal resources; and (3) the impact of such a designation on the environment, the economy, and the supply of coal. This statement shall be forwarded to the Secretary of the Interior for review at the same time a mining permit is forwarded for approval.

Archeological Historical Sites and Endangered and/or Threatened Species. Inventories will be conducted on the impacted lands by the surface managing agency and stipulations necessary to protect these resources will be included in the mining permit.

Federal Lessor Protection. Prior to approval of a mining and reclamation plan, the surface of the public lands will be inventoried for legally installed appurtenances. Agreements with the federal lessee will be reached or bonds will be obtained to insure that the lessor's investments are protected.

Reclaimability to Present Use. Prior to approval of a mining and reclamation plan, it will have to be demonstrated that the land can be reclaimed to its premining productive capability. Where the determination is made that certain lands cannot be reclaimed to the postmining land use, surface mining will not be permitted on these lands.

Performance Bonds. Surety bonds are required at the time of lease issuance and may be readjusted prior to approval of the reclamation plan. Minimum surety for reclamation is set by SMCRA at $10,000. In addition, a surety bond will be required to insure payment to the government for each ton of coal mined.

Water Quality Standards and Effluent Limitations. The requirements of 30 CFR 715.17 will be required to prevent additional contributions of sediment to streamflows or to runoff outside the permit area to the extent possible using the best technology currently available.

Use of Explosives. The requirements of 30 CFR 748 will be included as a requirement of any mining and reclamation plan submitted for approval.

Water Rights. The area around the proposed mining area will be inventoried for water uses and water rights. Special requirements will be included in the mining and reclamation plan to protect the water rights of others.

Revegetation. To insure that the proposed reclamation plan is being developed to meet the objectives of the postmining land use, the composition and density of plants necessary to meet the objectives of the post mining land use will be listed in the mining permit application. The surface managing agency (BLM) will inspect leases and permit areas for compliance with terms, conditions and stipulations relating to the management and protection of federal lands and resources and postmining land use.

Public Health and Safety. The authorized representative of OSM has the authority to enter and inspect for compliance with the initial performance standards in 30 CFR 715 and 716. He has the authority to order a cessation of mining or reclamation operations if, in the course of an inspection or investigation, he finds conditions, practices, or violations of the initial performance stand-

ards which create an imminent danger to the public health and safety, or conditions or practices which can be expected to cause significant environmental harm.

Forest Service

The FS manages the nation's forests and grasslands in accordance with the Multiple-Use Sustained-Yield Act of 1960 (74 Stat. 2.5, 16 U.S.C. 528 through 531). Rights-of-way on acquired lands in the national grasslands are granted under authority of the Bankhead-Jones Farm Tenant Act (50 Stat. 525; 7 U.S.C. 1010-1013) and the Federal Land Policy and Mangement Act of October 21, 1976.

Historically, lands managed by FS have been subject to mineral exploration and mining. Coal leasing development is subject to applicable laws and regulations and constraints developed in multiple-use planning.

A surface mining operation must reclaim the surface sufficiently to achieve a land configuration consistent with the purpose of the Bankhead-Jones Act and the current land use plan for the affected area. FS periodically reviews mining operations as they affect surface values.
Fish and Wildlife Service

Coordination is required with the U.S. Fish and Wildlife Service under provisions of the Fish and Wildlife Coordination Act, the Bald Eagle Act, and the Endangered Species Act. Refer to the previous sections on Fish and Wildlife Acts and Endangered Species for a discussion of the specific requirements.

State and County

State of Wyoming

DEQ. The Department of the Interior is negotiating a cooperative agreement pursuant to section 523(c) of SMCRA with the state of Wyoming. Whenever this agreement is consummated with the state, the OSM functions and responsibilities specified in this agreement will be delegated to the state regulatory authority (DEQ). Under this agreement, OSM and the state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to the officials authorized to take final action on the plans. The Secretary is prohibited by law from delegating his authority to approve a mining plan on federal lands. Under the terms of the cooperative agreement, DEQ will serve as the authorized representative of OSM in inspection and enforcement of the reclamation provisions of a mining permit. DEQ has authority relating to air quality, solid wastes and water quality. The Air Quality Division issues permits to construct and operate crushers or other point sources after approval of plans for monitoring and controlling air contaminants. The Water Quality Division issues permits to construct waste water systems. They also issue National Pollutant Discharge Elimination System permits for discharging waste water. The Solid Waste Division issues construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation of a coal mine.

Commissioner of Public Lands. Utility lines, roads, and railroad spurs, crossing state land require easements from the Commissioner of Public Lands (Wyoming Statutes 36-7).

Wyoming Highway Department. Relocation of highways and all utility line crossings of state and federal aid highways requires authorization from the Wyoming Highway Department.

Wyoming State Engineer. Any storage, impoundment, or use of surface or groundwater for mining and coal processing operations requires a permit from the State Engineer. Water pipelines and diversion structures that could affect another user also require a permit from the State Engineer.

The Public

Any person who is or may be adversely affected by a surface mining operation may notify the Regional Director of the Office of Surface Mining or his representative responsible for conducting inspections, in writing, of any violation of SMCRA which he has reason to believe exists at the surface mine site.

CHAPTER 4

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTIONS

The analysis developed in this chapter is a cumulative regional assessment of impacts through 1990 for all coal related development, plus concurrent activities affecting the region such as oil and gas, uranium, and water resource development.

The mining and reclamation plans in this statement were submitted for review during or prior to promulgation of the initial regulations (30 CFR 700) required under Section 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87). Therefore, in some cases, the mining and reclamation plans (M&RPs) may not fully reflect the requirements of the law and initial regulations. However, it is believed that they present sufficient data to permit analysis of the impacts that will be associated with mining in this area. Prior to departmental approval, the plans will be returned to the applicants for modification to incorporate the requirements of SMCRA. When the M&RPs are returned to the Department, they will be reevaluated to insure that they meet the requirements of SMCRA and appropriate federal regulations and that the potential impacts are covered by this ES. This procedure will facilitate the timely and efficient consideration of these applications under the evolving requirements of SMCRA, and it is believed the procedure is reasonable in view of the evolving character of the law.

CLIMATE

The proposed actions are not expected to significantly modify the climate and meteorology of the southcentral Wyoming ES region.

Temporary loss of vegetation in active mine areas of the three proposed surface mines may slightly decrease the amount of moisture locally available for the formation of thunderstorms during the late spring and early summer. However, the exposed soil would enhance convective heating, which is an important factor contributing to thunderstorm formation. Furthermore, increased atmospheric particulate loadings caused by the proposed surface mines may serve as condensation nuclei to augment precipitation. Nonetheless, any increase of thunderstorms caused by the lack of vegetation would be extremely localized. The modification of surface contours and albedo may cause local changes in wind speeds and directions, temperatures, and relative humidities.

AIR QUALITY

Introduction

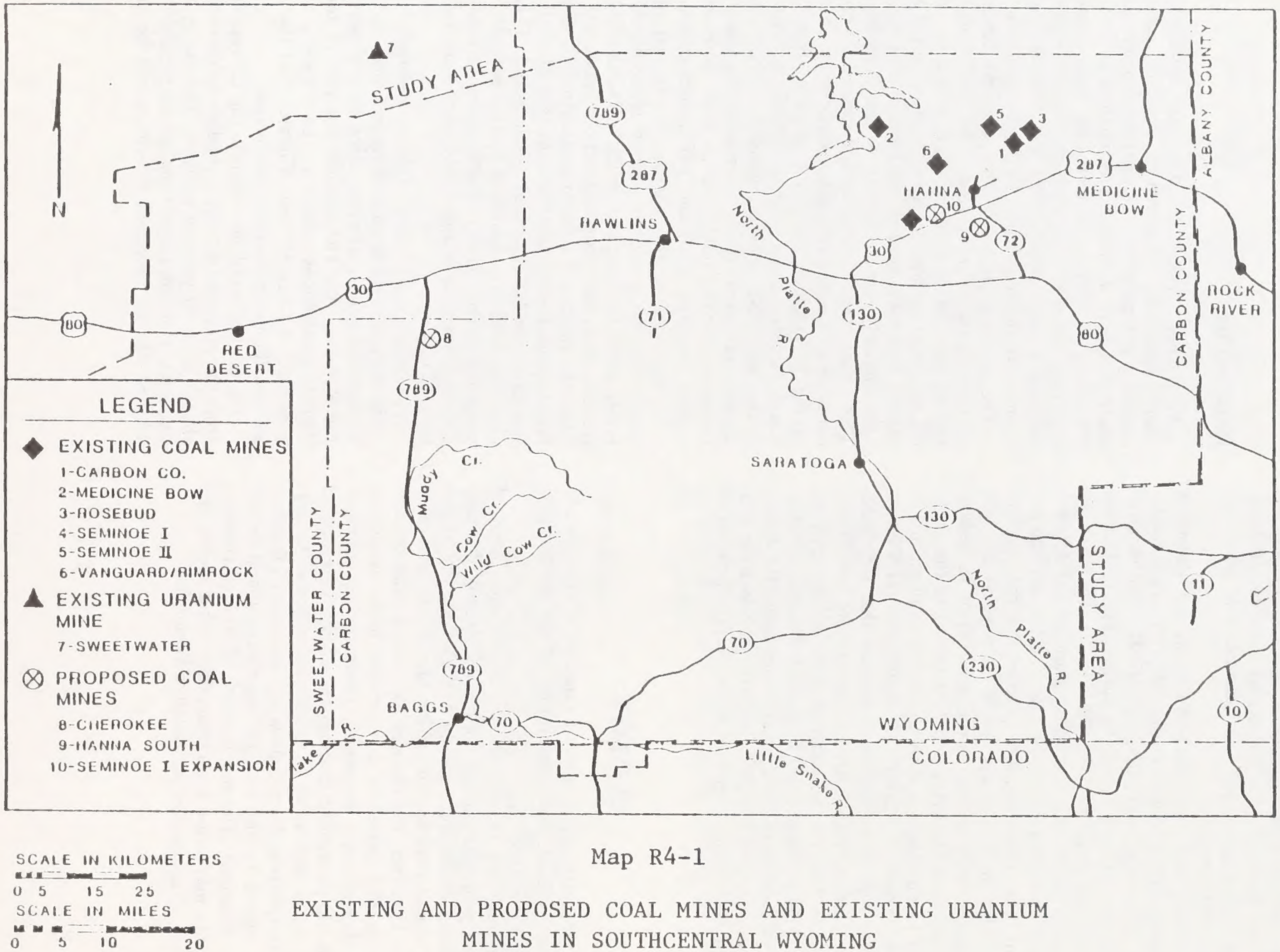
Air quality impacts caused by coal developments and related activities in southcentral Wyoming are addressed assuming a normal (or average) level of control. These controls include a normal precipitation pattern over the ES region as well as no new coal fires. Some existing fires may contribute to ambient concentrations of total suspended particulates (TSP), but they are already accounted for in the baseline TSP concentrations.

The primary impact of the proposed actions on air quality would be to increase the TSP concentrations around the surface coal mines. The federal coal could not be mined without releasing fugitive dust to the atmosphere. However, because the fugitive dust emissions are predominantly large particulates, significant increases of TSP concentrations from surface mining are expected to occur only within a few miles of the mine. In the towns of the ES region, population growth from the mines could increase sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and TSP concentrations due to residential and commercial space heating. Increased vehicular travel and transport of coal could produce local increases of NO_2, carbon monoxide (CO), and TSP concentrations.

In this section, the change in regional air quality caused by the proposed actions is evaluated for two levels. First, the increases of TSP, SO_2, and NO_2 concentrations from the proposed actions alone are assessed. Then the predicted ambient concentrations of these pollutants from the proposed actions as well as all other activities in the ES region are summarized. The pollutant concentrations are compared to the national and Wyoming ambient air quality standards and to the increments for the prevention of significant deterioration of air quality (PSD).

The maximum 24-hour TSP concentrations resulting from the proposed actions alone and from the proposed actions along with all other activities are summarized in the Regional ES. The detailed analyses of the 24-hour TSP concentrations caused by the proposed actions are presented in Chapter 3 and Chapter 6 of the individual, site-specific environmental statements.

The population of the towns in the ES region resulting from the proposed actions is predicted to increase by less than 7% for all years of analyses. The rise in TSP, SO_2, and NO_2 concentrations from urban population growth created by the proposed actions would be small. The



Map R4-1

EXISTING AND PROPOSED COAL MINES AND EXISTING URANIUM MINES IN SOUTHCENTRAL WYOMING

annual and short-term concentrations predicted for the towns without the proposed actions are presented in the low level scenario in Chapter 8.

Best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plans on file with GS were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. Chapter 8 of each site specific contains an air quality alternative which discusses the best management practice impacts for that specific mine.

Additional imformation on the impacts discussed in this chapter is documented in the Chapter 4 Regional Technical Report on file at the Rawlins District Office of the BLM.

Emissions

Air quality modeling requires as an input the pollutant emissions for each source modeled. Emissions were estimated for four different types of sources; surface and underground coal mines, uranium mines, towns, and transportation.

Coal mines are the major contributors of particulate emissions in the ES region. The locations of the mines modeled in this study are shown in Map R4-1. Fugitive emissions are produced by a number of activities within the mines, including blasting, coal and overburden loading and dumping, haul road and access road traffic, and wind erosion of exposed areas. For these operations, emission factors from the documents prepared by PEDCo Environmental, Inc. (1978), the Wyoming Department of Environmental Quality (1976), and Cowherd, et al. (1974) were used to relate the level of activity of an operation to fugitive dust emissions. Operating information was extracted from individual mining and reclamation plans. The annual emissions of particulates from the existing and proposed coal mines for 1980, 1985, and 1990 are shown in Table R4-1.

The Sweetwater uranium mill and mine would also generate significant amounts of fugitive dust. The major sources are mining operations, access roads, ore crushing and screening, conveying, and handling. Emissions were estimated using emission factors similar to those for coal mining. The annual particulate emissions from the Sweetwater mine and mill for the study years are also listed in Table R4-1.

Small amounts of pollutants are released from vehicles, steam generators, and other combustion sources within coal and uranium mines. Because of the small quantities emitted, the effects on surrounding air quality are expected to be insignificant (U.S. Department of the Interior 1976).

The three towns, Rawlins, Hanna, and Saratoga are anticipated to have a significant effect on regional air quality for TSP, SO_2, and NO_2. Current emissions for these pollutants were taken from the National Emissions Data System (NEDS) Inventory for 1977 (U.S. Environmental Protection Agency 1977). The total pollutant emissions for Carbon County were apportioned among the three towns based on the percentage of the county population in each urban area. The 1980, 1985, and 1990 emissions from the towns were forecasted to increase in direct proportion to projected growth in the population of the towns between 1977 and the study year. The population projections for the three towns are shown in Table R4-8. The TSP, SO_x, and NO_x emissions from the towns are listed in Table R4-2.

The proposed actions would increase the commuter traffic between the towns and mines, causing an increase in combustion and fugitive emissions from vehicles along some roads. The air quality impact of the emissions would be highly variable, intermittent, and generally confined to the immediate vicinity of the roads. Because of the small increase of vehicle travel expected for the proposed actions, the emissions from the vehicles would not have a significant impact on regional air quality. Hence, the vehicular emissions were not included in the dispersion modeling.

Significant changes in the air quality impact of oil and gas production are not expected during the study period. Oil and gas production may slightly increase above existing levels by 1990 in the region.

Construction of the proposed Savery-Pot Hook irrigation project is not expected to begin during the study period (Sersland 1978). The construction of a new Wyoming State Correctional Institute is scheduled to be completed by 1980. Neither of these projects were included in the dispersion modeling.

Modeling Procedures

The annual average SO_2, NO_2, and TSP concentrations were predicted with a model based on the steady-state Gaussian dispersion equation (Busse and Zimmerman 1973). Statistical meteorological data constructed from observations taken at the National Weather Service Station in Rawlins, Wyoming, for 1955 to 1964 was input to the dispersion model. The pollutant concentrations were computed for grid points (receptors) overlying the affected areas of the region. The modeling procedure for predicting annual pollutant concentrations from the mine and the urban areas is described in the technical report for Chapter 4 of the Regional Environmental Statement available at the BLM Rawlins District Office.

The modeling procedures used to predict the TSP, SO_2, and NO_2 concentrations around the towns are presented in the Chapter 4 technical report. The 24-hour and 3-hour TSP and SO_2 concentrations were estimated from the annual concentrations predicted for the towns using Larsen statistics (U.S. Environmental Protection Agency 1971). All emissions of sulfur oxides were assumed to be SO_2. All NO_x emitted to the atmosphere are assumed to be converted to NO_2.

Resultant Air Quality

TABLE R4-1

PARTICULATE EMISSIONS (TONS/YEAR) FROM EXISTING AND PROPOSED MINES

Mine	Year 1980	1985	1990
Existing Coal Mines			
Seminoe I	1,474	1,890	-
Seminoe II	2,012	2,012	2,012
Medicine Bow	4,572	4,415	4,415
Carbon County	256	312	367
Rosebud	2,225	2,225	2,225
Vanguard/Rimrock	1,113	1,113	1,113
Proposed Coal Mines			
Seminoe I Amendment	1,331	-	-
Hanna South	1,375	1,246	-
Cherokee	-	3,981	5,380
Sweetwater Uranium Mine	916	1,756	1,756

Table R4-2

ESTIMATED EMISSIONS OF PARTICULATE, SULFUR OXIDES, AND NITROGEN OXIDES (TONS/YEAR) FROM TOWNS WITHIN THE STUDY REGION

Year	City	Particulates	Sulfur Dioxide (SO_2)	Nitrogen Dioxide (NO_2)
1980	Rawlins	463	377	1,868
	Hanna	65	53	261
	Saratoga	75	61	303
1985	Rawlins	623	506	2,511
	Hanna	77	63	312
	Saratoga	79	64	319
1990	Rawlins	731	594	2,948
	Hanna	86	70	348
	Saratoga	82	67	330

Proposed Actions Alone

The area affected by the particulate emissions from the Seminoe I, Hanna South, and Cherokee Mines would be limited to a few square miles around the individual mines. The increase of annual TSP concentrations is predicted to be less than 1 microgram per cubic meter ($\mu g/m^3$) beyond 6 miles from the mines for the three study years (Maps R4-2 through R4-4).

The annual and 24-hour Wyoming ambient air quality standards would be exceeded at the mine boundaries from particulate emissions from the mines alone. At the mine boundaries, the total particulate emissions from the mines would cause the Class II increments for prevention of significant air quality deterioration (PSD) to be exceeded. Under the new PSD review procedure promulgated by the U.S. Environmental Protection Agency (43 CFR 118), the impact of fugitive dust emissions from surface coal mines would not be included in the air quality analyses for the PSD increments, nor for national ambient air quality standards. Particulate emissions from industrial process units of a surface mine are typically less than 2% of the total emissions from a mine. Hence, the surface mines of the proposed actions would not be expected to exceed the Class II increment under the new review procedure.

Because the new PSD review procedures had not been implemented by EPA at the time of this modeling effort, the regional air quality analysis has been prepared using the previous PSD regulations. The previous regulations require the air quality impact of all particulate emissions from surface mines be analyzed for PSD review. The worst-case situation is discussed, and best management practices will produce fewer and less intense impacts.

The proposed mines would have no impact on the air quality of the nearest Class I area, the Mount Zierkel National Wilderness Area. The wilderness area is about 70 miles south of the three proposed actions, well outside the area affected by particulate emissions from the mines.

Because Hanna, Wyoming, is as close as 1.6 miles to the north boundary of the Hanna South Mine, the mine would have a significant impact on the air quality of the town. In 1980, the annual Class II increment for TSP would be exceeded up to a distance of 0.8 miles north of the mine boundary. The 24-hour TSP increment would be exceeded at a slightly greater distance north of the mine. The TSP concentrations at the mine boundary from particulate emissions of the mine alone would cause concentrations higher than the Wyoming standards. In 1985, the mine is expected to have a higher impact on TSP concentrations in Hanna as the mining activities move northward in the project area.

The emissions from the Cherokee Mine alone are predicted to cause annual TSP concentrations greater than 100 $\mu g/m^3$ in an area a few square miles east of the mine in 1985 and 1990. In 1980, the emissions from the federal coal from the Seminoe I Mine would produce TSP concentrations greater than Wyoming air standards and Class II increments at the mine boundaries.

With application of the 43 CFR 118 regulations, it is unlikely that the violations discussed above would occur.

The rise in TSP, SO_2, and NO_2 concentrations from urban population growth created by the proposed actions is expected to be small. For all study years increases in the populations of Rawlins, Saratoga, and Hanna, generated by the three proposed mines, would be less than 7% of the population of the towns without the proposed mines.

During construction of the Hanna South and Cherokee Mines, increased overnight parking of semi-trailer trucks may cause a greater amount of blue haze to be formed over Rawlins during winter days following nights with ground-based temperature inversions. Emissions from the diesel locomotive from the one to two unit trains per day required in 1985 and 1990 to carry the coal from the three proposed mines would not cause the regional TSP, SO_2, and NO_2 concentrations to rise measurably. The emissions from the locomotives would be dispersed over a long line through the ES region.

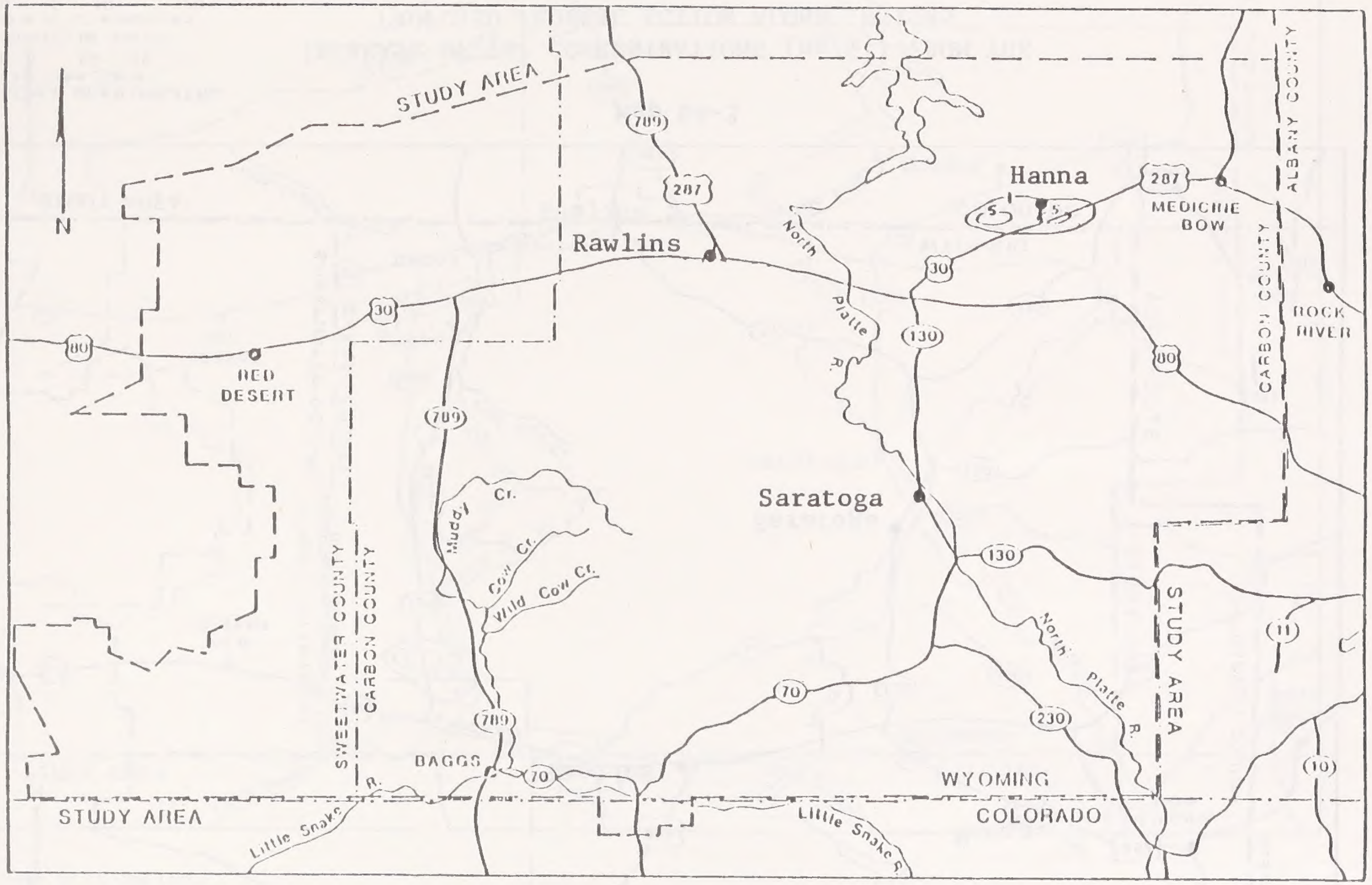
The commuter traffic to the proposed mines is not expected to measurably increase regional TSP, NO_2, and CO concentrations. The proposed mines and residences of the employees would be distributed widely throughout the region.

Interaction of the Proposed Actions and Other Activities

The proposed production of coal from public land from the Seminoe I Mine would not cause a change in the ambient air quality. The production of the federal coal would extend the life of Seminoe I Mine, but not increase the 2.3 million ton per year production rate of the mine. The 1.3 million tons per year of federal coal produced at the Seminoe I Mine in 1980 would also be offset by a comparable reduction of coal produced from private land. Hanna South Mine is predicted to cause ambient TSP concentrations greater than the Wyoming standards at the edge of the town of Hanna during the life of the mine. As seen in Maps R4-5 through R4-7, the particulate emissions from the Cherokee Mine would not interact with other major particulate emissions in the ES region. The annual TSP concentrations around the existing Medicine Bow Mine caused by the mine alone are predicted to continue to exceed the Wyoming air quality standards during the study period.

With the application of the 43 CFR 118 regulations, the violations of the Class II increment and the NAAQS would not occur.

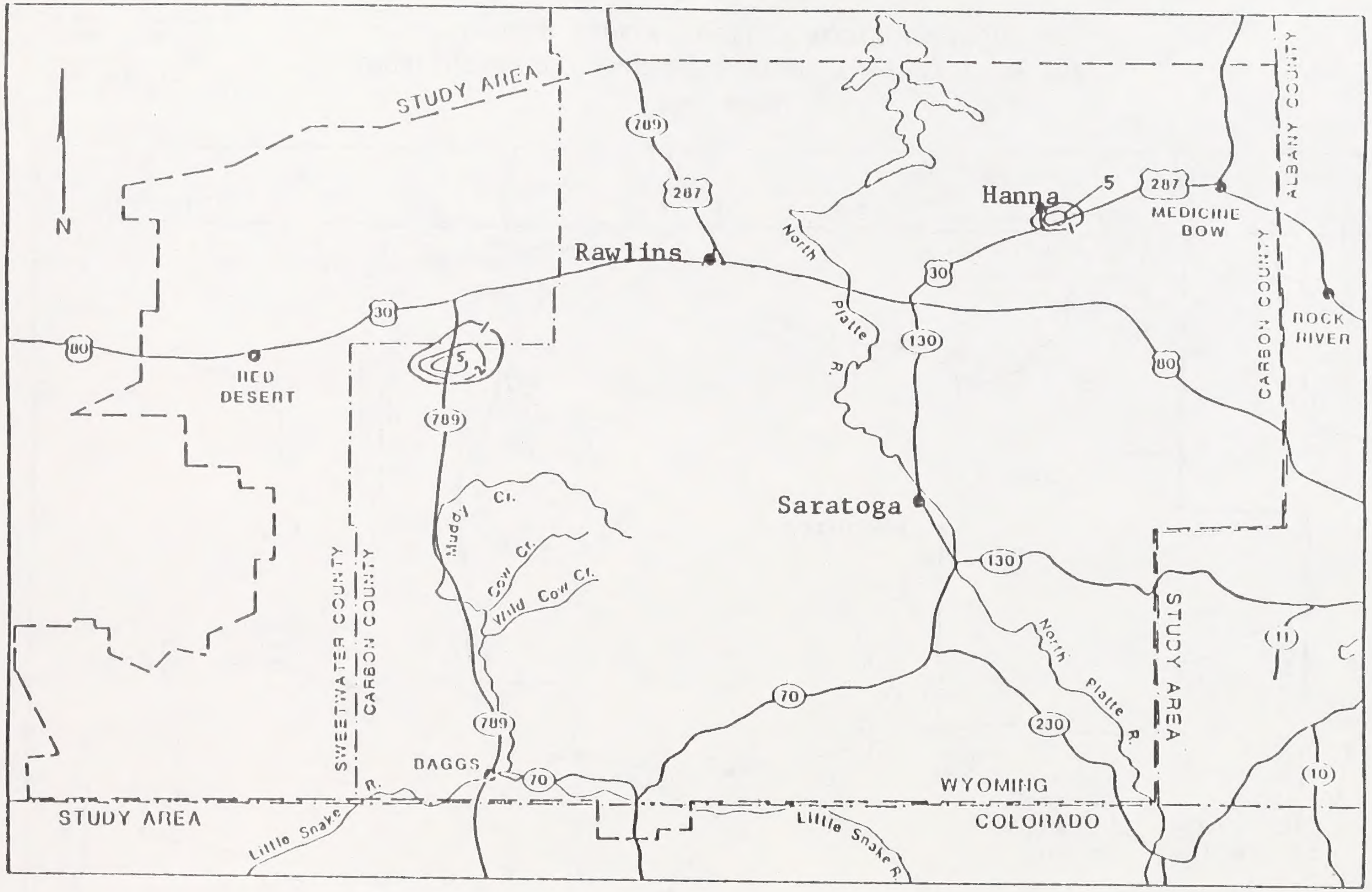
As mentioned in the previous subsection, the increase of TSP, SO_2, and NO_2 emissions in the towns of Rawlins and Saratoga due to population growth induced by development of the proposed mines would be negligible. Activities in the region other than the proposed actions would cause TSP concentrations to increase and to spread over a wider area around Rawlins. TSP increases near Rawlins would be a result of population growth associated with existing mines and other existing activities. The annual TSP concentrations in Rawlins are expected to increase without the proposed actions from 40 $\mu g/m^3$ in 1980 to 70 $\mu g/m^3$ in 1990. The maximum 24-hour TSP



SCALE IN KILOMETERS
0 5 15 25
SCALE IN MILES
0 5 10 20

Map R4-2

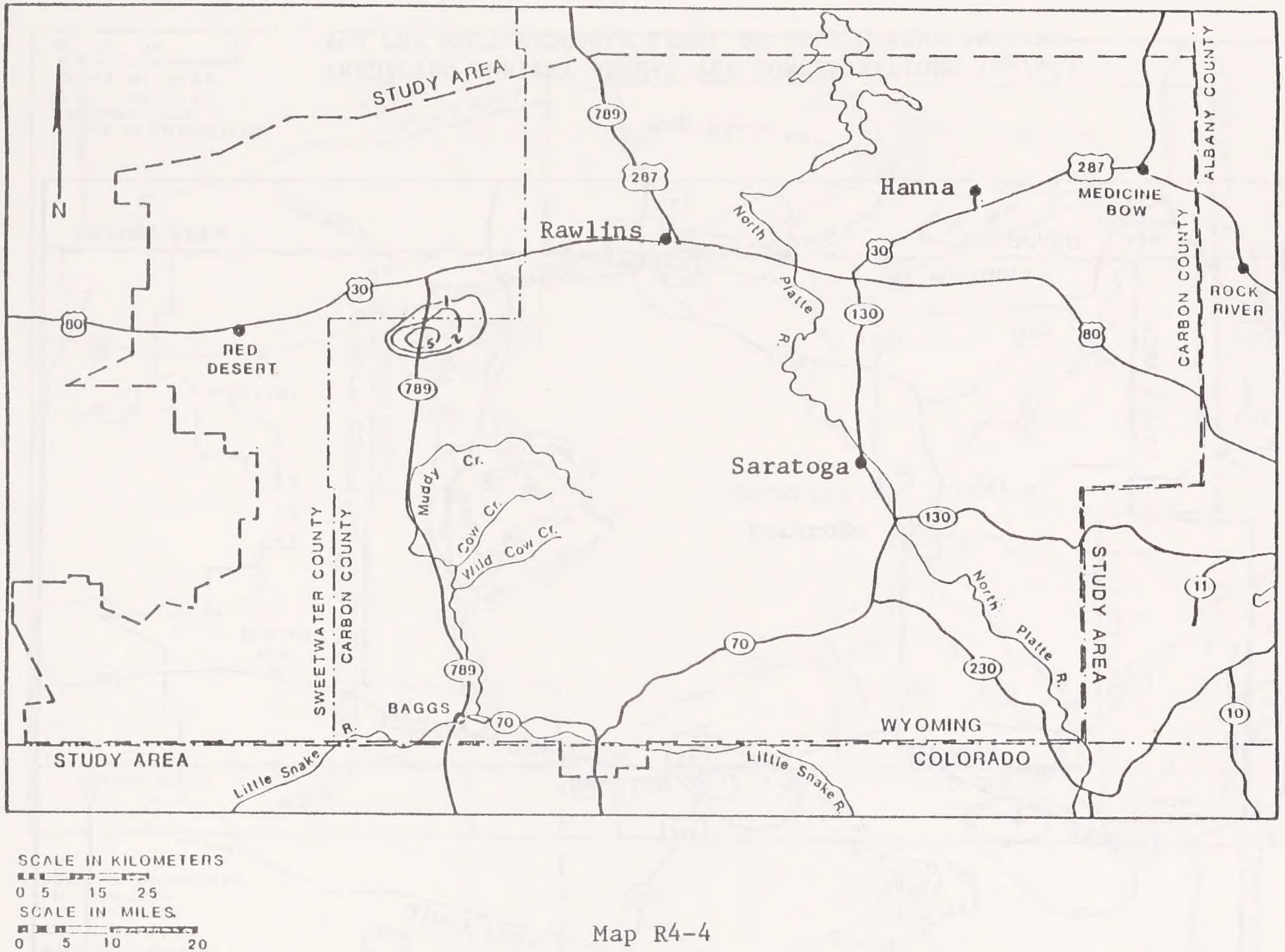
INCREASE OF TSP CONCENTRATIONS ($\mu g/m^3$) FROM THE PROPOSED FEDERAL ACTION ALONE IN 1980



Map R4-3

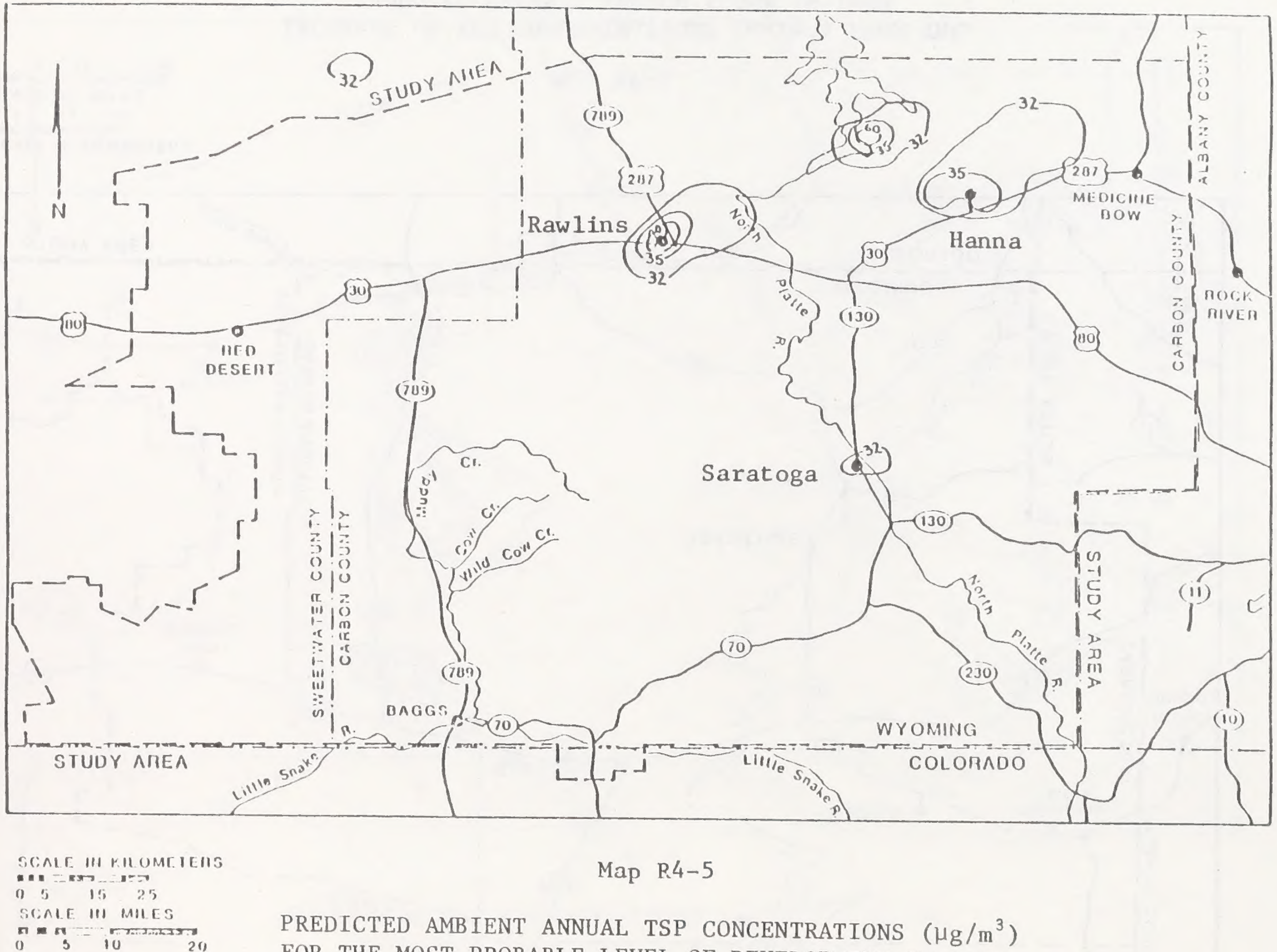
SCALE IN KILOMETERS
0 5 15 25
SCALE IN MILES
0 5 10 20

INCREASE OF TSP CONCENTRATIONS ($\mu g/m^3$) FROM THE PROPOSED FEDERAL ACTION ALONE IN 1985



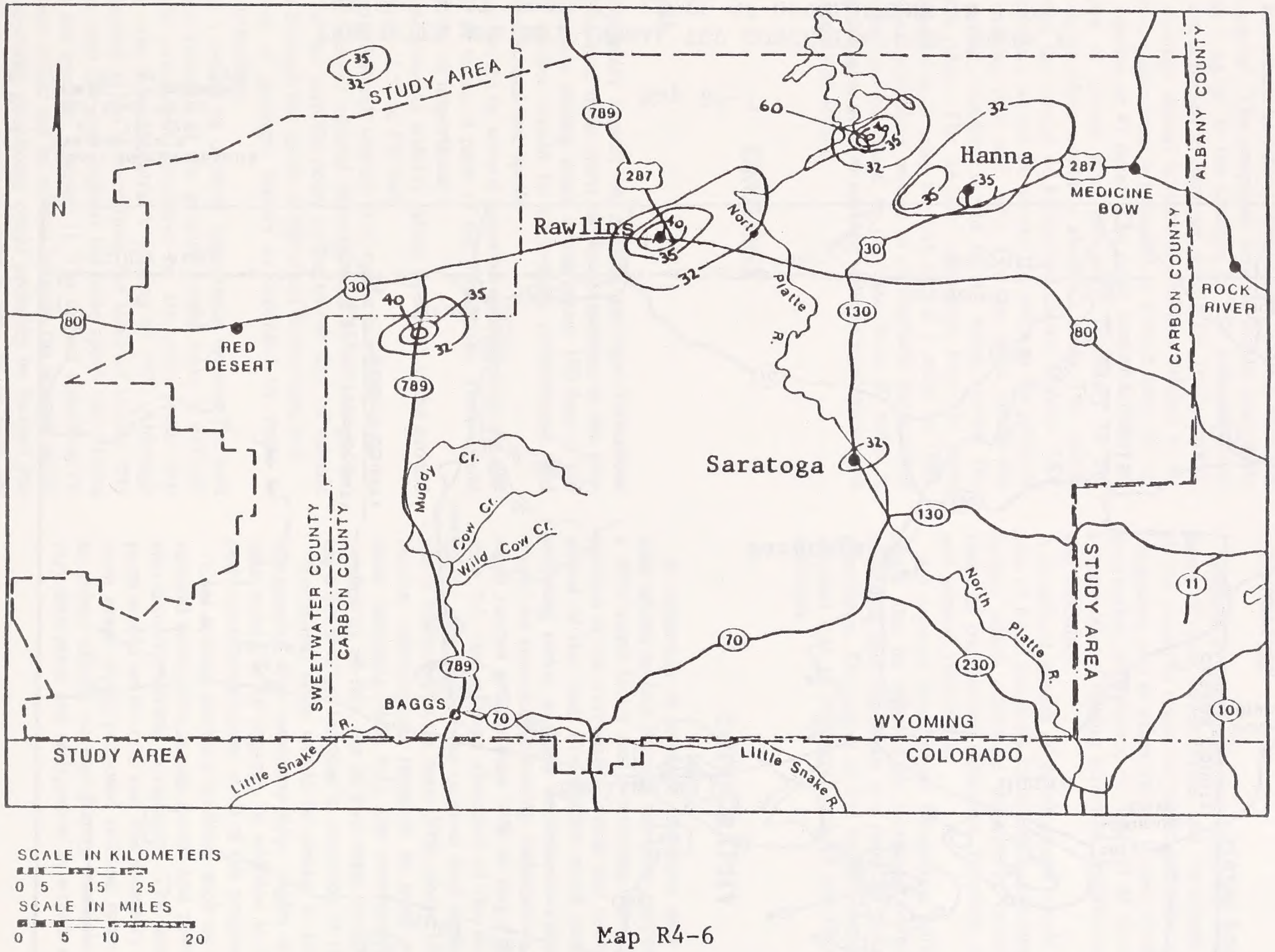
Map R4-4

INCREASE OF TSP CONCENTRATIONS ($\mu g/m^3$) FROM THE PROPOSED FEDERAL ACTION ALONE IN 1990



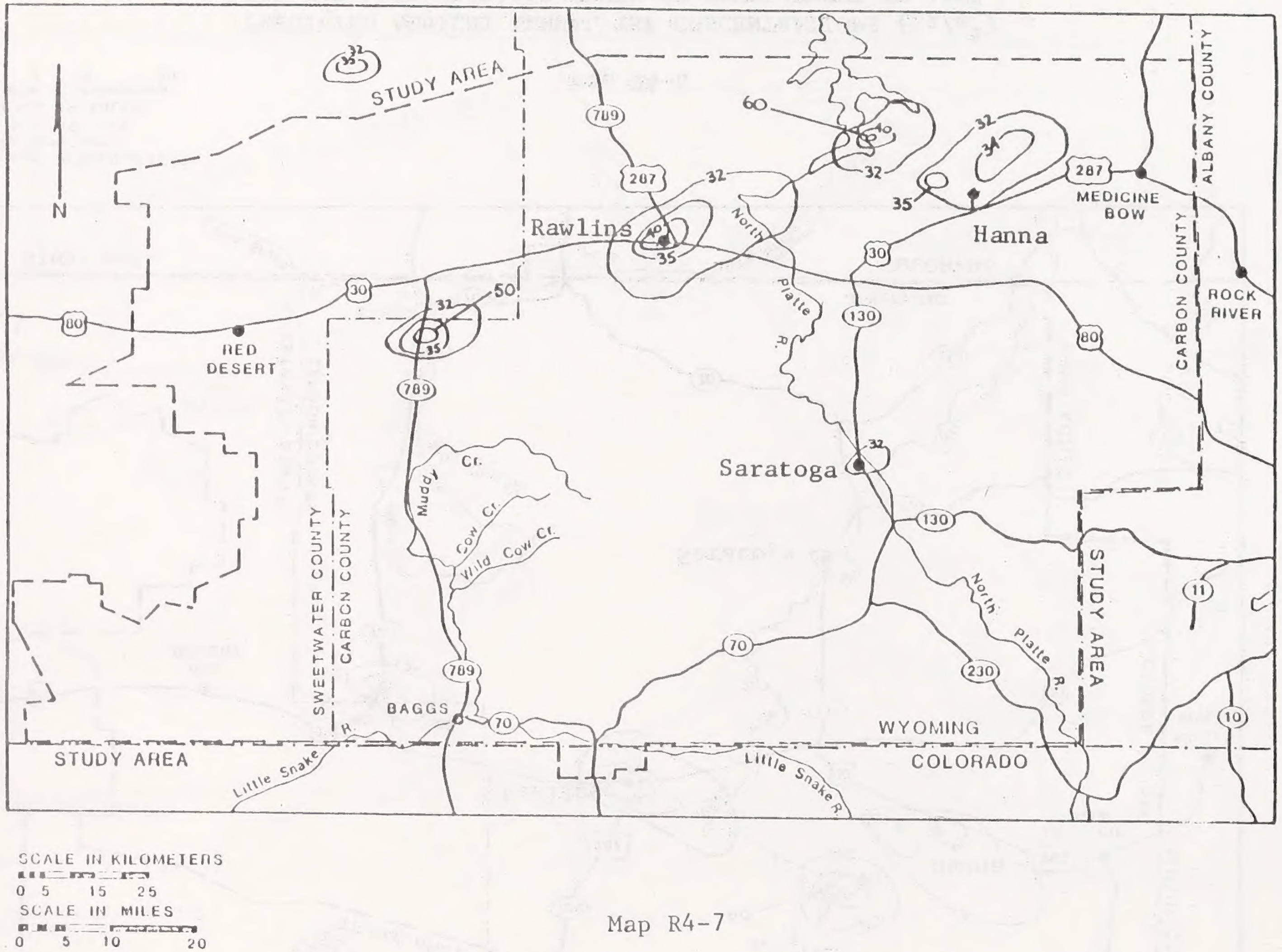
Map R4-5

PREDICTED AMBIENT ANNUAL TSP CONCENTRATIONS ($\mu g/m^3$)
FOR THE MOST PROBABLE LEVEL OF DEVELOPMENT IN 1980



Map R4-6

PREDICTED AMBIENT ANNUAL TSP CONCENTRATIONS ($\mu g/m^3$)
FOR THE MOST PROBABLE LEVEL OF DEVELOPMENT IN 1985



Map R4-7

PREDICTED AMBIENT ANNUAL TSP CONCENTRATIONS ($\mu g/m^3$)
FOR THE MOST PROBABLE LEVEL OF DEVELOPMENT IN 1990

concentrations are predicted to rise from 136 $\mu g/m^3$ to 238 $\mu g/m^3$ during the period. The 24-hour TSP concentration of 238 $\mu g/m^3$ in 1990 would exceed the national secondary and the Wyoming air quality standards of 150 $\mu g/m^3$ but would be below the national primary standard of 260 $\mu g/m^3$. The proposed actions would contribute less than 5 $\mu g/m^3$ to the changes in TSP concentrations which are expected in Saratoga during the study period.

The average annual horizontal visibility related to atmospheric particulates is expected to remain near the regional baseline of 47 miles. The mean annual visibility at the town of Hanna near the north boundary of the Hanna South Mine would be about 17 miles. The visibility during the period of highest predicted 24-hour TSP concentrations would be around 14 miles at the edge of Hanna during 1980 and 1985. For the same years, the mean annual visibility would be 17 miles around the Cherokee Mine. The 24-hour visibilities near the mine are estimated at 7 miles in 1985 and at 4 miles in 1990. The annual visibilities related to atmospheric particulates in Rawlins are estimated to decrease from 40 miles in 1980 to 29 miles in 1990 with or without implementation of the proposed actions.

GEOLOGY

General

The primary impact on existing geologic formations would be that those parts of the formations in the proposed surface mining areas within about 150 feet of the present surface would be excavated, redistributed, and thus transformed into spoils.

There would be several impacts resulting from the disruption of strata of parts of the formations. They would be in order of importance:

1. a decrease in stability (shear strength) of the ground to a depth of 50 to 150 feet;
2. more difficult seismic exploration in mining areas for possible deeper mineral deposits such as oil and gas because of the variable delay in the travel time of seismic waves through the spoils of disturbed formations; and
3. loss of geologic history as recorded by strata in these formations.

Item 1 would be of most importance because the lack of shear strength of the ground would make it difficult to build permanent structures on the mine spoils that would exist in southcentral Wyoming by 1990. Although not planned at the present time, the town of Hanna may expand into the area utilized for mine spoils (see Hanna South site specific, Chapter 1). The impact regarding exploration would not be critical because the seismic points and recording geophones could probably be located just outside the mine spoils in such a way as to time the travel of seismic waves that travel through strata of possible economic interest beneath the spoils. The loss of local geologic history (Item 3) would not be very important because most of the strata in these areas are rather uniform and the geologic history would be preserved in strata of the same formation outside the mine areas.

Paleontology

Impacts to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses would result from destruction, disturbance or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

All exposed fossiliferous formations within the region could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased regional population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

TOPOGRAPHY

A reduction in average elevation may occur at the sites where surface mining has been proposed. Assuming a 20% swell factor and a stripping ratio of 5:1, the expansion of the overburden would just compensate for removal of the coal. For smaller swell factors or smaller stripping ratios, a slight decrease in average elevations would be expected following reclamation. Similarly, for swell factors greater than 20% or larger stripping ratios than 5:1, the average elevation of the spoils would be higher than that of the original land surface. For example, if the swell factor were 30% where 120 feet of overburden removal was required to mine a 20 foot coal seam (stripping ratio 6:1), the overburden would have swelled by 36 feet, the 20 foot seam would be gone leaving a net average increase in elevation of 16 feet.

Reclaimed areas would be similar in form to existing topography. The maximum slope angles of the reclaimed land would be 16 degrees. In addition to the spoil areas, active cuts would exist at all of the proposed strip mines.

Coal related ancillary facilities such as buildings, new railroad spurs, new access roads, and power lines would also disturb existing topography. The most obvious impacts would be the cuts and fills necessary to maintain an even grade along proposed railroad spurs. There would be minor effects on topography associated with temporary disruption and realignment of stream channels.

SOILS

The mining of coal in the three proposed projects and associated housing and urban support facilities would

cause soil alterations cumulatively on 886 acres by 1980; 4,257 acres by 1985; and 5,904 acres by 1990.

Development of six existing coal mines would continue. This would cause a cumulative alteration of soil resources on 1,837 acres by 1980; 6,080 acres by 1985; and 10,370 acres by 1990.

The combined oil, gas, uranium, Savery-Pot Hook, sand and gravel, and other activities would cumulatively disturb soils on 680 acres by 1980; 1,571 acres by 1985; and 2,486 acres by 1990.

Population increases associated with the above developments would utilize soil resources in the ES area through demands for increased housing sites and other urban support facilities (Detwyler 1971). Cumulatively, this utilization of soil resources would occur on an estimated 200 acres by 1980, 455 acres by 1985, and 455 acres by 1990. The population increases would result in increased utilization of soil resources recreation, especially off-road vehicle use. This off-road vehicle (ORV) use would disrupt sensitive surface soils resulting in accelerated rates of erosion and compaction on localized areas. The increased losses would occur with or without the proposed actions, although the magnitude would be greater with the proposed actions (due to the population increase). The amount and extent of ORV use and disruption is unquantifiable.

Soil alterations at the three proposed projects would cumulatively affect 791 acres by 1980; 3,913 acres by 1985; and 5,560 acres by 1990 (see Table R4-3). This alteration and disturbance would impact soils by the destruction of existing soil characteristics and properties, and losses in soil productivity (Brady 1974; Bay 1976).

The alteration and destruction of existing soil resources by the proposed actions would be a short-term reduction of soil productivity on 5,560 acres by 1990; and a long-term utilization by 1990 of an additional 344 acres for housing and urban facilities. The losses of soil productivity would result from removal, handling, stockpiling, erosional losses, and utilization of overburden (spoil) as subsoil material (see Vegetation, Chapter 4).

Mining would involve the disturbance of soil on 4,605 acres (final contour) by 1990; with an average yearly disturbance of 384 acres. Mining in the proposed projects would involve the removal, handling, and stockpiling of topsoil and subsoil material where suitable. These actions would destroy existing soil structure and alter the soil ecosystem (biota). The excavation of overburden (to a maximum of 150 feet) with the resulting spoil piles and its utilization as subsoil material in reclamation would impact soils by changing the textures, structure, surface stability, bulk densities, infiltration rates, permeability, waterholding capacities, nutrient levels, and soil organic matter levels (Monsen 1975; Singleton and Cline 1976).

The new soils on the reclaimed areas would have properties that would depend upon the soil types salvaged and used in reclamation. It is estimated that these new soils would be composed of deep unconsolidated overburden material (subsoil) overlaid with a surface soil material averaging 6 to 12 or more inches thick. This new soil would have no structure and the surface material would range in textures from sandy loam to clay. The reclamation potential of these new soils would range from fair to unsuitable.

Increased erosional losses would occur from exposed spoil, topsoil stockpiles, and reclamation areas (before establishment of vegetation) (Dollhopf et al. 1977). It is estimated that wind erosion on exposed areas would average 0.42 ton/acre per year (see Air Quality). During periods of drouthy conditions, when sustained winds (30 to 50 mph) occur, the wind erosional losses would be more severe. The average water erosional rates would be an estimated 2.4 to 5.0 tons/acre per year over the exposed and unreclaimed (vegetation establishment) areas. At times when high intensity storms (occurring in the spring and summer months) occur over the exposed areas, the water erosion rates and soil losses could be considerably higher (see Water Resources).

The overall result of the proposed actions would be the disruption of 5,904 acres by 1990. This disruption would occur mainly on Ustic Torriorthents (mapping units 7, 44, and 52) and Borollic Haplargids (mapping unit 3), and Borollic Calciorthid (mapping unit 54). This would be 0.1% of the 5.5 million acres in the ES region.

The overall disruption of soil resources by the proposed actions, existing mines, oil, gas, uranium, Savery-Pot Hook, and sand and gravel developments would occur on 18,760 acres by 1990. This would be about 0.34% of the 5.5 million acres in the ES region.

WATER RESOURCES

Most impacts associated with strip mining such as those resulting from interception of groundwater and surface runoff, increased mineralization, acidic water, and sediment production would be noticable only in small local areas. Likewise, the small increases in water use caused by the mines (Table R4-4 and Figure R4-1) would have only local impacts. By 1990, municipal use in the region would reach 5,610 acre feet per year (ac ft/yr) if no new mines were started and 5,870 ac ft/yr if the three proposed mines become operational.

The increase would occur mostly in Rawlins where both the supply and the distribution system are inadequate to meet further demands. The existing system is not capable of meeting the present peak one-day demand: HTNB (1977, supplement) has estimated that the system will not meet the yearly demand by 1981 and that there could be no carry over storage by 1984. With predicted growth and no additional coal mines, Rawlins will be using 3,800 ac ft/yr by 1990 (present rate is 2,200 ac ft/yr); with the three proposed mines the city would use 4,000 ac ft/yr. The additional demand caused by the mines would be small in relation to demands resulting from other causes. The mines would increase water use by 20 ac ft/yr in Hanna and less than 10 ac ft/yr in Saratoga. Other towns would be unaffected. By 1990 industrial use would reach 1,300 ac ft/yr without the mines and 1,950 ac ft/yr with the mines. Most of the increase would occur due to the Cherokee Mine where 570 ac ft/yr of water from deep aquifers would be used for washing coal and dust control.

Table R4-3

CUMULATIVE ACRES DISTURBED BY ACTIVITY
RELATED TO PROPOSED PROJECT AREAS BY TIME PERIODS

Activity	Time Period 1980	1985	1990
Final Contour	677	3,138	4,605
Mine Facilities	95	349	349
Ancillary Facilities	19	400	400
Relocation of Facilities	--	26	206
Subtotal	791	3,913	5,560
Housing etc.	95	344	344
Total	886	4,257	5,904
Acres Reclaimed	6	1,615	2,497

Table R4-4

PROJECTED USE OF WATER WITH PROPOSED ACTIONS
(In ac ft/yr)

Time and Degree Of Regional Development	Uses Impacted By Coal Mining		Uses Not Impacted By Mining			Total Use
	Municipal Supply In The Region	Industrial	Irrigation & Related Evaporation	City of Cheyenne	Livestock	
1977	3,600	1,100	209,100*	8,000	1,200	223,000
1980						
With No Additional Coal Mines**	4,190	1,170	209,100	8,000	1,200	223,660
With Proposed Mines***	4,220	1,250	---	---	---	223,770
Amount Attributed to Proposed Action****	30	80	---	---	---	110
% Increase Due To Proposed Action	0.7	6.8	---	---	---	0.05
1985						
With No Additional Coal Mines	5,040	1,200	209,100	34,000	1,200	250,540
With Proposed Mines	5,290	1,760	---	---	---	251,360
Amount Attributed to Proposed Action	250	560	---	---	---	810
% Increase Due To Proposed Action	5.0	47	---	---	---	0.3
1990						
With No Additional Coal Mines	5,610	1,300	253,100	34,000	1,200	295,210
With Proposed Mines	5,870	1,950	---	---	---	296,120
Amount Attributed to Proposed Action	260	650	---	---	---	910
% Increase Due To Proposed Action	4.6	50	---	---	---	0.3

* 1948 to 1968 average from Wyoming State Engineer; use rate has remained fairly constant. Figures are considered representative of current uses. Irrigation use was assumed to remain constant until Savery-Pot Hook project would be completed in the late 1980s.

** Projected use of water if none of the proposed actions described in Chapter 1 are implemented.

*** Projected use if the proposed actions are fully implemented.

**** The difference between uses for the two degrees of development is attributed to mining.

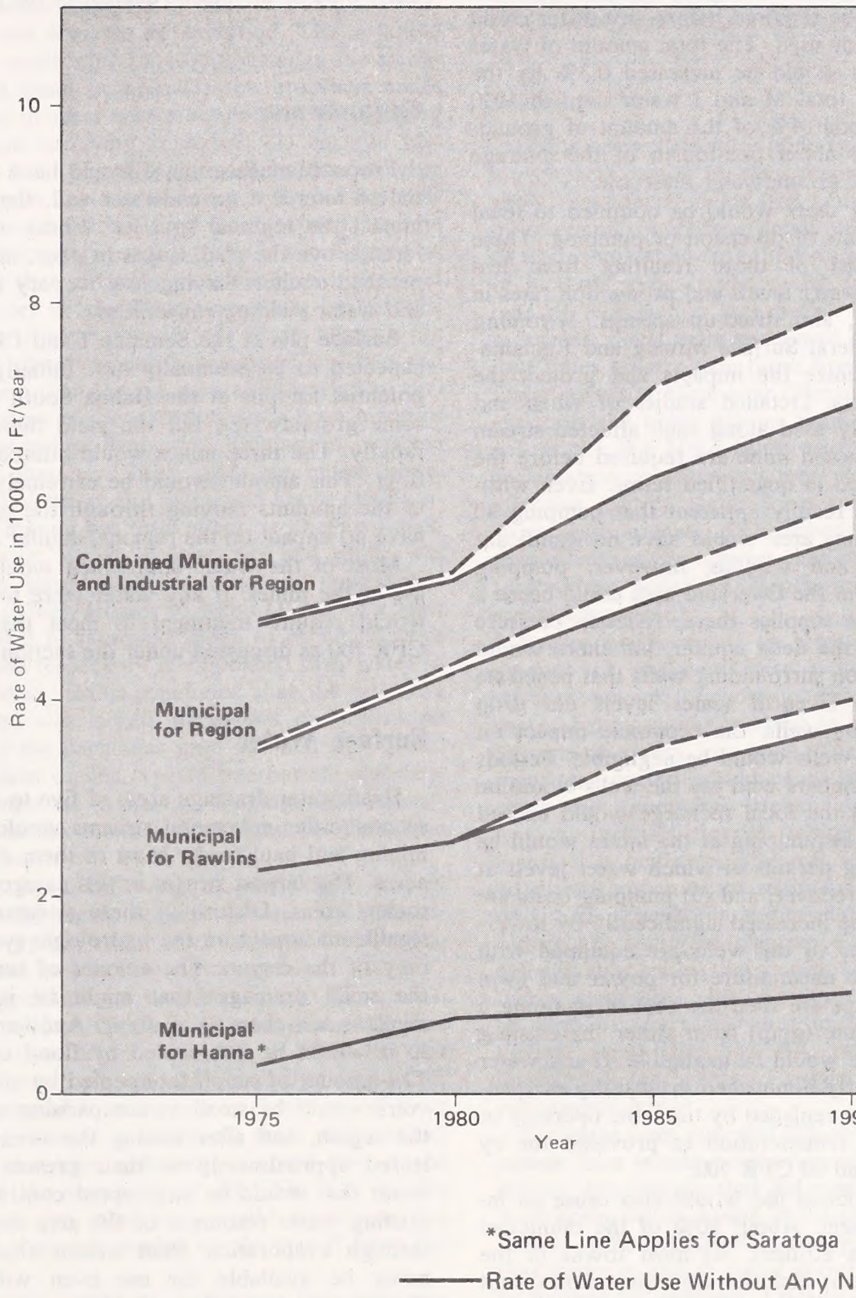


Figure R4-1
PREDICTED WATER USE WITH PROPOSED ACTION

Water taken for Municipal and Industrial (M and I) uses would not be available for other uses, but the amounts would be small in comparison to total resources; therefore, the mines would cause little impact on the water-related economy of the region. Permits from the state engineer would be required before any water could be diverted, pumped or used. The total amount of water used for all purposes would be increased 0.3% by the proposed mines. The total M and I water used in 1990 would be equal to about 4% of the amount of groundwater in storage and about one-fourth of the average annual recharge to the groundwater reservoir.

Impacts on existing users would be confined to local areas close to the points of diversion or pumping. These impacts would consist of those resulting from less streamflow, lowered water levels and production rates in wells close to mines, and dried-up springs. Wyoming state laws and the federal Surface Mining and Reclamation Act would minimize the impacts and protect the rights of existing users. Detailed studies of when and how water is presently used along each affected stream and around each proposed mine are required before the impacts can be assessed in quanitified terms. Even without such studies, it is readily apparent that pumping 80 ac ft/yr from the Hanna area would have no significant impact on ranchers and wildlife; however, pumping about 600 ac ft/yr from the Overland area could cause a slight impact to water supplies there. Artesian pressure would be reduced in the deep aquifer, but there would be little or no impact on surrounding wells that penetrate the shallow aquifers. Even if water levels did drop slightly in some nearby wells, the economic impact on ranchers who use the wells would be negligible. Periods in which impact on ranchers who use the wells would be negligible because: (1) the local recharge would exceed the amount pumped; (2) pumping at the mines would be sporadic, thus allowing periods in which water levels at the stock wells could recover; and (3) pumping costs are small and would not be increased significantly by lowering water levels. Many of the wells are equipped with windmills requiring no expenditure for power and even where motorized pumps are used the cost of pumping 5 to 10 gallons per minute (gpm) from either the existing or lowered water table would be negligible. If any water supply were significantly diminished in quantity or quality, it would have to be replaced by the mine operator or paid for with proper renumeration as provided for by Wyoming state laws and 30 CFR 700.

An increase in municipal use would also cause an increase in sewage effluent. About 80% of the municipal water supply becomes effluent. At most towns in the region, sewage treatment facilities are either nonexistant or inadequate. New facilities will be required at most communities whether or not the proposed actions are implemented. The proposed mines would cause the amount of effluent from Rawlins to be 5% greater than it would be without the mines. The treatment facilities planned for completion in 1979 are being designed to handle a larger population than would result with proposed mines. Therefore, sewage effluent resulting from the proposed actions would cause an insignificant impact. Water released to Sugar Creek from the treatment plan would have about one-eighth the biological oxygen demand (B.O.D.) of the present discharge. The amount of discharge would double so that the net B.O.D. in the effluent would be about one-quarter of the present.

Groundwater

Proposed surface mines would have a very low potential to intercept groundwater and, therefore, would not impact the regional aquifers. Where water was encountered above the coal, it was in poor, often discontinuous, perched aquifers having low to very low permeabilities and water yielding capabilities.

Surface pits at the Seminoe I and Cherokee Mines are expected to be essentially dry. Initially, there would be potential for pits at the Hanna South Mine to intercept some groundwater, but the yield there would decrease rapidly. The three mines would intercept less than 50 ac ft/yr. This amount would be extremely small in relation to the amounts moving through the ground and would have no impact on the regional aquifer system.

Most of the water intercepted would be retained for use at the mines. If any water were to be discharged, it would require treatment to meet the standards of 30 CFR 700 as discussed under the section on quality.

Surface Water

Head water drainage areas of five to ten small first and second order ephemeral streams would be disturbed by mining and haul roads. Most of them drain less than 100 acres. The largest stream in this category drains about 3 square miles. Disturbing these streams would have no significant impact on the hydrologic system or the economy of the region. The amount of surface runoff from the small drainages that might be intercepted by all mines is less than 50 ac ft/yr. Another few hundred ac ft/yr would be intercepted by flood control reservoirs. The amount of runoff intercepted by mine pits and reservoirs would be small in comparision to total runoff of the region, and after mining the streams would be restored approximately to their present state. Also, the water that would be intercepted contributes little to the existing water resources of the area since it is now lost through evaporation from stream channels and would never be available for use even without the mines. Therefore, interception of surface runoff by mine pits would have no impact on the region. Settling basins and flood control reservoirs would make water more accessible and would provide new watering spots for livestock and wildlife. The watering spots would be temporary except for those provided by flood control reservoirs outside the mine area at Hanna South, which would be permanent.

Quality

In some areas, strip mining can create a potential for groundwater to become more highly mineralized and/or acidic, because some minerals in the disturbed overburden could be made soluable by oxidation. The potential for increased mineralization of groundwater in the southcentral region is small because (1) the proposed mines would be located in areas where aquifers are discharging water rather than receiving recharge; (2) harmful elements have not been found in the overburden in large enough quantities to cause problems; (3) few of the minerals that are found in the overburden would become more soluable after mining; and (4) the low precipitation makes it unlikely that sufficient minerals would be added to the groundwater to impair its present use by animals. Mineralization of surface flow is not likely because the concentration of dissolved solids permitted by state and federal laws is less than the concentration generally carried by natural streams. Few studies have been made of mineralization resulting from strip mining in western states and those that have been made are inconclusive. Rahn (1975), VanVoast et al. (1976), and Davis (1977) indicate that strip mining has little effect on chemical quality of groundwater. Water in mine pits and spoils was virtually of the same quality as that in undisturbed aquifers (Davis 1976a). However, Rahn (1976), in a later study, found water in saturated spoils to be much more highly mineralized (especially in sulphates) than water in undisturbed aquifers. Rahn concluded that the potential for mineralization was largely dependent on infiltration characteristics of the particular spoil pile and that this in turn was dependent on the type of overburden and how much it was compacted in placing, shaping, and reclamation. The potential for mineralization must be studied on a mine-by-mine basis.

The potential for acidic water is particularly low in the southcentral ES region because waters are highly alkaline, and iron pyrite, sulfur, and other acid-producing minerals are found in very low concentrations.

Surface and groundwater in the proposed mine areas are naturally poor (see Chapter 2), having much higher mineral content than is permitted by 30 CFR 700 and Wyoming state laws. It is not anticipated that any water, either that intercepted in mine pits or direct runoff from disturbed areas, would be released from the project areas. If any water were released, it would have to be treated to meet the standards of 30 CFR 700. In this case, runoff from the mine area would contribute less dissolved solids than are carried by the runoff from undisturbed areas.

Coal wash water would be discharged into mine pits on the Cherokee site, but most of this would be returned to the washing system, thus leaving little potential for contamination from this source (see Cherokee site specific, Water Resources).

Selenium and uranium are found in some parts of the geologic formations that would be disturbed, but not at the proposed mine sites; therefore, no contamination is expected from these elements.

A possibility exists for the quality of perennial streams to deteriorate slightly because of increased recreational use. There is no way to quantify such an impact, but it could not be greatly significant since the population resulting from the three proposed mines would be only 5% of the total regional population that would exist in 1990.

Sediment

Sediment produced by mine spoils is an issue in assessing impacts caused by strip mining. Most studies to date show that source yields (the amount of sediment moved by overland runoff from small plots of ground) are greater from spoils than from undisturbed soil, but the amount of increase varies widely with soil types and effectiveness of reclamation (see Soils). Lusby and Toy (1976) measured yields from reclaimed spoils that were two to four times greater than those from undisturbed soil at the Dave Johnston Mine near Glenrock, Wyoming, and several hundred times greater than those from undisturbed soil at the Big Horn Mine near Sheridan, Wyoming. If reclamation or other treatment of spoils was sufficiently effective, source yields from spoils could be less than those from natural, undisturbed soil. Reclamation with this effectiveness appears unlikely in the southcentral region (see Soils and Vegetation) and no other treatments are planned.

Source yields would be only remotely related to the amount of sediment that would be transported by streams. Several hydrologic and legal requirements discussed below would combine to reduce the transport and impacts to a very low level. The small amounts of sediment transported would cause little regional impact because the ephemeral streams draining the mine areas have no fisheries, riparian habitat, or man-made developments that could be affected. Under normal operating conditions, much of the sediment generated in mine areas would be retained in sedimentation basins. This would reduce the sediment transported by streams to a level considerably below that transported under existing undisturbed conditions. Sedimentation basins would have to be kept in operation until untreated runoff from disturbed areas met SMCRA requirements. Thus post mining sediment transport would also be below that from undisturbed basins.

Sediment from cuts and fills along roads, railroads, and power lines would not have a significant impact on the region. Any impact that did result would be confined to local areas within a mile of the sediment source. There is seldom sufficient runoff to transport the sediment beyond that distance, and as stated above, nothing exists that can be harmed by sediment. Locally, stream gradients of half a dozen ephemeral streams crossed by transportation and power facilities could be altered as sediment was deposited upstream from culverts and erosion occurred downstream, but again, there would be no regional impact.

The primary reasons for drawing the above conclusions on sediment transport are:

1. No perennial streams exist within or close to any area that would be disturbed by mining.

2. All proposed mining would progress down the dip of the geologic strata.
In general, this is also down the topographic gradient. Most of the runoff (both water and sediment) generated on the spoils would be intercepted by mine pits and depressions.

3. Wyoming law and SMCRA require that any runoff not intercepted by pits must be passed through a sedimentation basin. The sediment concentration in water released from the basin must be less than 30 milligrams per liter (mg/l), whereas natural runoff contains concentrations of several hundered mg/l. During floods having an occurrence probability of less than 0.1, the sediment concentration immediately below a settling basin would be less than 5% of the concentration that would have existed under natural undisturbed conditions. During floods having occurrence probabilities in the range 0.1 to 0.04, the sediment concentration would approach that from a natural basin. Larger floods could carry larger concentrations of sediment. The total amount of sediment transported over a period of several years would be much less than the amounts presently transported by these streams. The combined probability of an extreme peak discharge of long duration and an uncleaned full reservoir would reduce the probability for release of a large slug of sediment to about 0.01 or 0.02; whereas the probability of a similar slug of sediment being discharged under natural conditions is about 0.1. (The distance along the stream from the settling basin and character of the stream channel would determine sediment concentrations at other points on the stream.)

4. SMCRA regulations require that sedimentation basins ponds be cleaned to maintain full removal capacity. This will virtually eliminate the potential for large amounts of sediment to be released by a pond failure. The material cleaned from the basins must be buried or, if of satisfactory quality, it can be used as topsoil for reclamation; thus there is little possibility of sediment being carried from disposal areas.

5. Evaporation in the settling basins would reduce the streamflow by 50% to 75%, and would, therefore, reduce the stream's capacity to carry sediment.

6. Direct runoff from perimeter slopes of spoils would not be sufficient to transport sediment beyond the base of the slope. Large deposits of sediment have been observed at the base of existing spoils near Hanna, but little evidence could be found of sediment being transported more than 200 feet from the base of the slope. If there was sufficient runoff to carry sediment, it would have to be diverted through settling ponds to meet requirements of the 1977 Surface Mining Control and Reclamation Act.

VEGETATION

Terrestrial

A cumulative total of 18,760 acres of vegetation is projected to be disturbed by coal and other energy resource related development by 1990. This represents .33% of the 5.5 million acres contained in the ES region. The average disturbance by other time periods would be 3,403 acres by 1980 and 11,908 acres by 1985. Table R4-5 displays the acreage disturbed by vegetative type and time period.

Vegetative disturbance would begin on the proposed projects by mid 1979 in the Hanna area. By 1980, a total of 886 acres would be disturbed including acreage utilized as housing and support service sites. During the 1981 to 1985 period, development would continue in the Hanna area and be initiated on the ore project in the Overland area. Cumulative vegetative disturbance during this time period would be 4,257 acres. In the 1986 to 1990 period, development in the Hanna area proposed project would be completed and would be continued in the Overland area. Cumulative vegetative area disturbed by 1990 on the proposed projects would be 5,904 acres. Table R4-6 displays the acres to be disturbed by individual projects during the designated time periods. Table R4-3 (Soils) depicts the acreage of disturbance that would occur as related to the mining activity during the time periods.

The vegetative disturbance that would occur on the existing mines would be confined to the actual mining area since the mine and ancillary facilities needed to service the mine are already in place. Cumulative acreage of vegetation disturbed by the existing mines would be 1,837 acres by 1980; 6,080 acres by 1985; and 10,370 acres by 1990.

The cumulative acreage of vegetation disturbed by all coal related activity would be 2,723 acres by 1980; 10,337 by 1985; and 16,274 acres or .3% of the ES region by 1990.

Combined oil, gas, uranium, sand and gravel activities would disturb 680 acres by 1980, 1,571 acres by 1985; and 2,486 acres by 1990.

After the initial 2 year period at each mine, it is assumed that the acreage disturbed each year would not exceed the acreage of land receiving reclamation measures. Since disturbance would occur at a rate of approximately 384 acres (final contour) per year on the proposed mine sites, and 855 acres per year on the existing mines in the ES region, and reclamation accomplished at a like rate, the amount of unreclaimed disturbed acreage on the proposed mines and existing mines would not exceed an estimated 2,478 acres at any one time. Owing to climatic conditions and soil characteristics of the area and based on observations of other reclamation efforts (existing mines, roadside cuts and fills, borrow areas, rangeland reclamation, etc.) over the past 10 years, it is assumed that reclaimed areas would not attain adequate vegetative cover of any type until 7½ years after initiation of reclamation efforts. With this premise, it is estimated that the total acreage at any one time that would not have adequate vegetative cover would not exceed 8,054 acres (2,496 acres on proposed mines; 5,558 acres on existing mines). This acreage would be composed of 2,478 acres of unreclaimed disturbed lands and 5,576 acres of reclaimed (topsoil replaced and seeded) lands in

Table R4-5

CUMULATIVE ACREAGES, BY VEGETATIVE TYPES, THAT WOULD BE DISTURBED, BY TIME PERIODS, BY PROPOSED PROJECTS, EXISTING MINE AND OTHER ENERGY RELATED RESOURCE DEVELOPMENT

Vegetative Type	Time Period	Proposed Projects	Existing Mines	Other	Total
Sagebrush	1980	723	1,488	584	2,795
	1985	3,573	4,803	1,300	9,675
	1990	5,093	8,293	1,672	15,058
Bird Foot Sage	1980	155	300	80	535
	1985	349	1,110	235	1,694
	1990	404	1,800	400	2,604
Greasewood	1980	3	4	2	9
	1985	120	15	5	140
	1990	132	25	10	167
Grassland	1980	5	10	4	19
	1985	11	35	11	57
	1990	11	60	21	92
Mountain Shrub	1980	--	15	--	15
	1985	--	45	--	45
	1990	--	72	230	302
Saltbush	1980	--	20	10	30
	1985	--	72	20	92
	1990	--	120	35	155
Riparian	1980	--	--	--	--
	1985	--	--	--	--
	1990	--	--	118	118
Barren	1980	--	--	--	--
	1985	204	--	--	204
	1990	264	--	--	264
Total	1980	886	1,837	680	3,403
	1985	4,257	6,080	1,571	11,908
	1990	5,904	10,370	2,486	18,760
% of ES	1990	0.10	0.19	0.05	0.34

Table R4-6

CUMULATIVE AREAS DISTURBED BY PROPOSED PROJECTS DURING PERIODS OF TIME

Project	Period of Time		
	1980	1985	1990
Cherokee	--	2,023	3,540
Hanna South	318	754	884
Seminoe I	568	1,480	1,480
TOTAL	886	4,257	5,904

various stages of vegetative establishment, but still unable to sustain any use of the vegetation.

The destruction of vegetative cover would result in impacts on livestock, wildlife, recreation, aesthetics, soil, and water. Within the reclamation process, the establishment of vegetative cover has to be accomplished before satisfactory control of soil erosion, improvement of water quality, or any use of the area by man or animal is feasible. In a localized area, strip mining causes a greater impact than most other land uses, both aesthetically and biologically. Attempts to restore vegetation are often difficult, and the problem is compounded when native plants are desired to retain compatibility with undisturbed areas (Monsen 1975). The success of vegetative rehabilitation depends upon a number of climatic and biotic factors as well as the type of disturbance. Revegetation is also dependent upon artificial restoration measures since severely disturbed areas recover very slowly through natural regeneration. Many game and livestock ranges cannot be returned to full productivity with present techniques and procedures (Monsen 1975). Mine sites in the western United States with high salinity, low annual rainfall, and poor fertility are difficult to revegetate once existing species have been destroyed. Problems would vary among mining sites and revegetation cannot be based on a single group of plants. However, the intermixing of forbs and shrubs in direct seeding often results in the loss of the slower developing seedlings of the latter due to competition.

Complete data on reclamation success on mined areas in the southcentral region are not available. Preliminary success, based on observations of seedings on reclaimed areas less than 4 years old, has been minimal and in some cases a total failure. These minimal results are attributed primarily to climatic conditions (low precipitation, low humidity, strong winds, etc.); also to the method of handling overburden, parting material, and topsoil and to the minimal use of seed mixture, contour furrowing, and mulching (reference, Chapter 2, Vegetation). In view of problems anticipated in establishing vegetative cover, it is estimated that one out of three seeded areas would have to be reseeded one or more times before adequate cover would be established. It is also concluded that the established vegetative cover would be predominated by perennial grasses since forbs and shrubs would not be able to compete unless special measures were initiated to establish shrub cover.

Reclamation as outlined in the proposed reclamation plans is expected to result in vegetative type conversion to grassland from the vegetative types (sagebrush, mountain shrub, saltbush, etc.) now present on the proposed mining sites. This is likely to occur since it would be difficult to reestablish the plant species indigenous to the specific area by the seeding method. Reestablishment of native species (sagebrush, rabbitbrush, saltbush, native grasses, and forbs) is expected to occur through natural succession over the long term (40 to 50 years) unless special measures are initiated.

Since the management objective is to restore the lands as sheep and cattle range and habitat for wildlife in a timely manner, additional measures would have to be incorporated into the reclamation plans for the proposed projects. The application of these additional mitigating measures (Chapter 4, site specifics) would be necessary to attain the objectives of post mining land use of requirements of the law. With the application of the additional mitigating measures, the vegetative productivity of the reclaimed lands is expected to be regained within 10 to 15 years after reclamation has been completed.

The vegetative type that would receive the largest impact would be the sagebrush-grass type which occupies approximately 79% of the area involved in mining operations and other energy resource development activities. Table R4-6 displays the acreage of vegetation disturbed by coal development and other energy resource development in the region.

Increased dispersed recreational use, particularly that involving off-road vehicle travel would cause the disturbance of indeterminate amount of vegetative cover. Baseline data are not available on acres of vegetation disturbed by this activity. An indication can be drawn from the magnitude of the anticipated population increase (refer to Recreation and Socioeconomics).

Another population related impact to vegetation would be wildfires. In 1976, 994 acres of vegetation were destroyed in the ES region by 24 wildfires. The usual causes are lightning or human activities. The incidence of lightning caused fires (8 in 1976) is expected to remain relatively constant since little or no change is anticipated in the climatic condition or fire potential in the vegetative communities of the region. The number of man-caused fires (16 in 1976) is expected to increase with expansion of the population. Accordingly, the average number of man-caused fires that would occur annually would be approximately 27 by 1980, 29 by 1985, and 31 by 1990. The average annual acreage of vegetation destroyed by wildfire would be approximately 1,414 acres by 1980; 1,490 by 1985; and 1,566 by 1990. Acreage estimates are tempered with a reminder that a large wildfire during any one year can destroy several hundreds of acres in a relatively short period of time.

Another impact from the destruction of vegetative cover could be the invasion of noxious weeds or other less palatable species of vegetation onto the disturbed areas. These weedy species would compete with revegetation efforts and could inhibit the establishment of desired permanent vegetative cover.

Young, palatable plants produced by revegetative efforts would attract livestock and wildlife. The grazing of the young plants would inhibit growth vigor and could cause a delay in the establishment of vegetative cover.

Aquatic

All of the proposed mining locations are drained by ephemeral streams that flow at limited times such as during spring runoff and after intensive summer rainstorms. Owing to the ephemeral characteristics of the drainages and in view of erosion control measures outlined in the mining plans, the impact on aquatic vegetation from these three sites is expected to be minimal.

The Savery-Pot Hook project would affect the aquatic vegetation of the Little Snake River and Savery Creek. The impacts on the aquatic vegetation expected from these developments are impossible to evaluate at this time since no information is available concerning the quantity or quality of aquatic plant life in these streams.

Endangered and/or Threatened

The southcentral coal areas were surveyed for endangered or threatened plants during the summer of 1977. No threatened or endangered plants were found (reference Regional Analysis, Chapter 2, Vegetation).

FISH AND WILDLIFE

It is anticipated that the proposed actions would result in some impacts to the wildlife resources of the region. These impacts to the wildlife resource can be broken down into two general categories: (1) loss of wildlife habitat and the associated wildlife carrying capacity of that habitat; and, (2) the actual loss of wildlife populations, their progeny, their progenies progeny, and so on, over the entire period of mining and reclamation.

Habitat Losses

The proposed mine plans would remove a total of 5,904 acres out of 5.5 million acres of wildlife habitat by 1990. The greatest amount (95%) of vegetation removed by the proposed mines would be in shrub habitat which supplies food, cover, and rearing habitat for a majority of the wildlife species in the region.

Included within these removed acres are 344 acres that would be permanently lost to wildlife due to construction of permanent housing and support facilities. The only wildlife populations disturbed by loss of these 344 acres would be small songbirds and small nongame rodents since the habitat included within this acreage is located immediately adjacent to existing housing or commercial developments. Very few, if any, big game species can be found in these areas because of human activities.

The actual acreage of vegetation lost to the proposed actions would range from 886 acres in 1980 to 5,904 acres in 1990 (see Table R4-6). Since it is estimated that the reclamation of disturbed areas would take 10 to 15 years to return to premining shrub habitat, all of the disturbed acreages would be lost to full wildlife use for this time period.

In addition to vegetative habitat removed by mining activities, there would be additional losses of wildlife habitat associated with mining that could be classified as indirect losses. These types of losses would be those areas of habitat that are not physically removed, but are areas that are outside the mined area that become temporarily unusable by wildlife because of isolation, noise, dust, etc. These areas of indirect loss could also be called a "zone of influence"around mining areas. The zone of influence around a mine site would be a different size for each species of wildlife under consideration, because each species has a different tolerance for man and his activities and each species also has its own cruising radius.

Fish and Wildlife Population Losses

Introduction

Wildlife populations inhabiting areas that are disturbed by the proposed actions would be lost or at best reduced with the advent of mining activities. Estimates of these losses can be calculated by using various population analysis formulas (Bowden 1966 in Boyd 1970; Selleck and Hart 1957; Wyoming Game and Fish Department 1977c; WELUT Team 1978). Data necessary to run a simulation are available only for pronghorns, mule deer, elk, and sage grouse.

Fishery

Under the proposed actions, impacts to any regional fishery would be nonexistent. Increases in human populations associated with mine development, however, would increase fishing pressure on streams, lakes, and reservoirs in the region (see Recreation Resources for a discussion of anticipated increases in fishing pressure).

Existing mines, proposed oil and gas exploration or development, and uranium exploration are not anticipated to have any adverse impacts to regional fisheries. The Savery-Pot Hook project would innundate 3.8 miles of Savery Creek, 1.2 miles of Little Sandstone Creek, and 1 mile of Big Sandstone Creek. Streamflows in nearly 6 miles of the Little Snake River would be reduced by this project.

Nongame

Losses to nongame fishes are not anticipated from the proposed actions since no streams or lakes would be affected by these actions.

Nongame fish would be adversely affected by the Sandstone Reservoir of the Savery-Pot Hook project. The estimated 6-year construction period would increase stream turbidity and sedimentation and would kill off or inhibit aquatic species in Savery Creek. For a complete analysis of the impacts of this project refer to the Draft Environmental Statement of the Savery-Pot Hook Project 1976 (DES 76-37).

Game

It is not anticipated that there would be any losses to game fish from the proposed actions since no reservoirs, lakes, or streams would be affected by these projects. Adverse impacts to sport fish and the sport fishery in the

vicinity of the Savery-Pot Hook project are anticipated and are well discussed in the Savery-Pot Hook DES.

Wildlife

In addition to direct losses due to mining, there would be losses to all wildlife populations which would not be caused directly by any surface mining activities. The increase in human population due to mine activities would result in increased habitat deterioration due to off-road vehicle use, increased illegal shooting of wildlife, and automobile/animal collisions.

While these losses would occur, their effect upon the total regional population would be negligible.

Birds

Nongame. The principal small songbirds that would be impacted by the proposed actions would be; horned lark, Brewer's sparrow, sage sparrow, vesper sparrow, sage thrasher, green-tailed towhee, and rock wren. The best population density estimates currently available indicate that there are an average of 21 breeding pairs of small birds per 100 acres in the various vegetative types found in the region. These types of small bird populations tend to replace themselves every 3 years. Using these assumptions, it is obvious that large numbers of birds are produced and lost every year. Over the period of mine activity, losses would be considerable, but because of a lack of detailed mortality data, a real-life simulation of small bird populations cannot be run. It is estimated, however, that losses of these species would be less than 1% of the regional small bird population. In summary then, losses of small birds would be high on all disturbed areas, but the high productive potential of these birds would allow them to repopulate the area as soon as habitat was available from reclamation.

The proposed actions would disturb one golden eagle nest and an unknown number of other types of raptor nests. The Bald Eagle Protection Act of 1940 requires the protection of the golden eagle and its nests. Consultation has begun with the Fish and Wildlife Service to protect the active nest.

Game. The sage grouse is the only major upland game bird in the region that would be impacted by the proposed actions. A total of three strutting grounds or leks would be destroyed by the proposed actions. A total of 11,719 acres of crucial nesting habitat, within the project areas would be destroyed or rendered unusable. Over the period 1979 to 1990, a total of 12,781 sage grouse would be lost to both hunters and nonconsumptive users due to the proposed actions. These losses would be less than 1% of the regional sage grouse population.

Nesting habitat for mourning doves would also be removed by the proposed actions. There are no good estimates of the dove production from habitat on the proposed mine sites, but the quality of the nesting habitat is such that production would not be high. It is estimated, however, that losses of doves from the proposed actions would total less than 1% of the population in the region.

Mammals

Nongame. The principal small nongame rodents found on the proposed sites include; deer mice, least chipmunk, Richardson's ground squirrel, whitetail prairie dogs, Uinta ground squirrel, and whitetail jackrabbits. The removal of topsoil and its storage for later reclamation would cause direct mortality to small burrowing rodents. Losses due to these factors plus other mine related activities would not only result in direct mortality, but losses would also be caused by displacement of more mobile animals.

Because the reproductive rates of these animals are so high and population turnover is so rapid, large numbers (not quantifiable with present data) of these animals are produced and lost each year. Over the period of mine life and reclamation, even larger numbers could be projected as lost due to proposed actions. These losses, while large, are estimated to be less than 1% the total regional population of these small mammal species. While these large numbers would appear to be significant losses, the high reproductive potential and natural cyclic population fluctuations of these animals indicate that rapid repopulation of disturbed areas would take place.

Game. The principal game mammals impacted by the proposed actions would be; pronghorn, mule deer, and cottontail rabbits.

The proposed actions would disturb a total of 5,904 acres of pronghorn habitat. Of these 5,904 acres, 4,514 acres would be classed as year-round range, 487 acres are noted as winter range, and 903 acres are classed as crucial winter range. Compared to the total pronghorn range available in the region, impacts from the proposed actions would not be significant, since there are an estimated 4,624,300 acres of pronghorn range in the region of which 966,155 acres are classed as winter range. The proposed actions would also result in the loss of an estimated 397 pronghorns by 1985 and 1,830 animals by 1990. Again, these losses would not be significant when compared to the estimated regional pronghorn population of 44,000 animals (Wyoming Game and Fish Department 1977d).

The three proposed actions would disturb an estimated 5,560 acres of year-round range for mule deer. At the present level of knowledge, there are no areas of strictly winter range or any areas classed as crucial winter range that would be lost as a result of the proposed actions. Impacts to mule deer by the proposed actions are not anticipated since the deer can easily move into adjacent habitat that is below mule deer carrying capacity. Compared to the amount of mule deer range available in the region (3,596,100 acres), the small number of acres and even smaller numbers of animals involved do not indicate any significant impact to mule deer habitat or populations. It is estimated that less than 1% of the regional mule deer population occurs on the proposed mine sites.

The destruction of 5,560 acres of brushland habitat by the proposed actions would result in direct losses (not quantifiable at present levels of knowledge) of cottontail rabbits on the project areas. While these losses would appear to be significant, the high reproductive potential of these animals would enable them to repopulate the mined areas quickly after reclamation is complete. It is estimated, however, that these losses are less than 1% of the regional cottontail population.

Reptiles and Amphibians

General

Principal reptile and amphibian species that could possibly be impacted by the proposed actions include; eastern shorthorned lizard, northern side-blotched lizard, northern plateau lizard, prairie rattlesnake, tiger salamander, and Rocky Mountain toad. Population densities are thought to be low in the region, since the secretive nature of these species makes detailed inventory data extremely difficult to obtain. Enough is known, however, to speculate that losses due to the proposed actions would quickly be replaced as soon as reclamation is completed.

Feral (Wild) Horses

Impacts to feral horses are not anticipated on any of the proposed mine sites, since no horses are found on any of the sites.

Endangered and/or Threatened

At the present time it is not anticipated that there would be any impacts to any endangered or threatened mammal species. However, in accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation and has contracted with the U.S. Fish and Wildlife Service for an intensive search for ferrets which will be conducted in the region during August and September, 1978. A final report on the inventory will be available in October, 1978.

It is not anticipated, at the present time, that there would be any adverse impacts to any bird species in this category by the proposed actions. This is based upon surveys by the Wyoming Game and Fish Department and the BLM which indicated that no bird species in these categories occur on any of the proposed mine sites. Data indicate that there is a possibility that the Hanna South and Seminoe I sites may be used by migrating bald eagles and peregrine falcons. In accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter dated August 11, 1978.

Adverse impacts to fish, reptiles, or amphibians in a threatened or endangered category are not anticipated since there are no known listed species on or near any of the proposed mine sites.

CULTURAL RESOURCES

Possible adverse effects of any development as listed by the Advisory Council on Historic Preservation consist of (1) destruction or alteration of all or part of property, (2) isolation from or alteration of its surrounding environment, or (3) introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting (36 CFR 800.9). Possible effects are not limited to these criteria, and each project must be evaluated to determine effects to specific cultural resources. Cultural resource inventories and compliance required by the Historic Preservation Act of 1966 and Executive Order 11593 must be conducted before approval of any federal action; however, projects without federal involvement may not always be inventoried.

Special stipulations requiring mitigation or salvage of cultural resources can be used on federal projects to reduce adverse effects. This method allows for recovery of significant amounts of scientific data. However, current research methods and priorities may overlook sites or portions of sites which would have been important to future research. Also, some sites not selected for salvage may be destroyed with recovery of only preliminary inventory data. These decisions may result in loss of valuable cultural resources.

Activities affecting cultural resources in the region include coal mining, oil and gas development, railroad, road, and utility construction, off-road vehicle use, vandalism, and private land development. These activities involve both federal and nonfederal actions.

Cultural resource inventories of planned or projected developments represent over 98% of the acreage inventoried in the region and account for over 95% of the known sites.

Coal development in the region has accounted for the largest percentage (94%) of cultural resource inventories. On a regional basis, 100% of the land approved for coal development has been inventoried. To date, no significant loss of cultural resource data has occurred because mitigation has been possible on all significant sites, and because no sites which deserve long-term protection for future research or preservation have been identified on coal tracts. Coal development has provided funding for cultural resource studies in an area which previously had not received much professional interest.

Intensive cultural resource inventories have identified 18 sites, within the three proposed project areas, which require additional testing to fully evaluate their significance. After this evaluation, suitable mitigating measures will be developed, under the procedures of 36 CFR 800, which would prevent the loss of significant cultural values. The other 60 sites identified within areas which would be directly effected by the proposed projects have

been fully evaluated and determined to be of no further significance.

The potential for unknown buried archeological sites exists within each project area and associated rights-of-way. Unknown Early period and Altithermal sites would most likely have been covered with Quaternary deposits through time and, because of their scarcity, would be significant in the region if they exist. These sites are not and would not be evident before actual surface disturbance uncovered them. Any surface disturbing activity could partially or completely destroy them, and the site pass unnoticed.

The State Historic Preservation Officer and the Advisory Council on Historic Preservation are being consulted per 36 CFR 800 in evaluating the significance of individual sites and in developing specific measures to prevent the loss of cultural values.

Increased populations would cause increased vandalism both to known sites and uninventoried sites. Presently, very few sites have been identified which have not been damaged to some extent, and any increase in vandalism may impair the future research of significant values.

VISUAL RESOURCES

The greatest visual impacts would be experienced where the region's federal, state, and county roads provide access to or near the mining areas. Map 1 in Appendix A depicts the proposed mining areas and Map 10 depicts the VRM classes. Activities and developments which would adversely affect the visual quality would be the placement of access roads, rail spurs, power lines, pipelines, and structures on the landscape. Even more critical would be the strip mining and other mining developments and surface disturbances which would adversely affect the visual resources.

As the access roads, rail spurs, power lines, pipelines, and other structures are constructed, they would place intrusions on the landscape which would contrast with the basic elements of form, line, color, and texture. This would result in a change of VRM class from a Class III to a temporary Class V. After mining and reclamation, the developments would be removed and disturbed areas seeded. This would reduce the impacts so that only the elements of color and texture in the vegetation feature would have contrast.

The strip mining and other mining development and surface disturbances would completely eliminate the characteristic landscape on the mined areas. There would be strong contrasts on all the basic landscape elements (form, line, color, and texture). This would result in a change of VRM class from a Class III to a Class V. After the mined areas are rehabilitated, the areas would not be returned immediately to the condition which existed prior to mining, since there would be changes in topography. The plant species that would be planted would be mostly grasses which would create moderate to strong contrasts on the elements of line, color, and texture.

RECREATION RESOURCES

Visitor Use Data

Table R4-7 depicts the resident recreation use by activities for the southcentral Wyoming region. The data used to derive these figures are available to the public at the Rawlins District Office of the Bureau of Land Management.

By 1990, the majority of recreational use within the region would take place away from the communities on private ranches, state lands, and public lands (University of Wyoming 1976).

In other impacted areas within Wyoming (Eastern Powder River), as populations increase, access to private lands is restricted, resulting in even greater decrease in available recreational resources. The result would likely cause additional problems for areas outside the region as hunters and other recreationists attempt to pursue their activities elsewhere (University of Wyoming 1976).

Some recreational use conflicts may occur as a result of the predominant socioeconomic group making up the majority of the new population. As a result of new mining operations, access to previously unavailable recreation resource lands may be established, and may tend to offset impacts in certain areas.

Overall, it is projected that the proposed mining would result in a diminished resource available for recreational uses. As a result, more services would have to be planned and managed on the remaining resources in order to maintain an acceptable recreation experience. The monetary cost of these services is not quantifiable with present data. The proposed actions may also influence the long-term economic strength of specific leisure related businesses. Increased recreation use may have an impact upon those resources in adjacent regions. The result may be a widening sphere of lessened recreation quality throughout the region, especially as additional regions are proposed for similar actions.

Based on all the known information, and extrapolating from other impacted areas, new recreational activities are not likely to be introduced in the region to any great extent.

Hunting

Hunter days are difficult to predict, given available data. However, a significant increase is anticipated in hunter use. When population and recreational use levels increase, more private land may become closed to public hunting, or a fee may be required for hunting on private land. Residents have been very reluctant to pay hunting fees to landowners, and rapid, rather significant changes would have to take place in the attitudes of landowners and hunters if current hunting experiences are to continue. The loss of private land or access across private land to hunting could be more significant than the physical loss of land to coal mining and related activities. Hunting quality within the ES region is not expected to return to

Table R4-7

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO POPULATION CHANGE
FOR YEARS 1980, 1985, 1990

	Fishing	General**	Hunting (Big Game)	Off-Road Vehicles	Urban Recreation***	Water Sports****	Winter Sports*****
1977 18,484	78,893	98,705	28,476	2,957	46,949	35,489	9,427
1980 (population 161)* 22,201							
without proposed action	93,670	120,339	28,872	3,526	60,169	44,300	12,343
increase due to proposed action	684	879	211	26	440	324	90
total projection	94,354	121,218	29,083	3,552	60,609	44,624	12,433
% of projection due to proposed action	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
1985 (population 1,314)* 27,848							
without proposed action	114,892	149,916	34,494	4,246	78,806	56,518	16,982
increase due to proposed action	5,690	7,424	1,708	210	3,902	2,799	841
total projection	120,582	157,340	36,202	4,456	82,708	59,317	17,823
% of projection due to proposed action	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%

Table R4-7

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO POPULATION CHANGE
FOR YEARS 1980, 1985, 1990
(Continued)

	Fishing	General**	Hunting (Big Game)	Off-Road Vehicles	Urban Recreation***	Water Sports****	Winter Sports*****
1990 (population 1,402)* 31,713							
without proposed action	132,762	175,198	39,404	4,850	94,872	66,987	20,612
increase due to proposed action	6,141	8,103	1,823	224	4,389	3,098	953
total projection	138,903	183,301	41,227	5,074	99,261	70,085	21,565
% of projection due to proposed action	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%

*Population changes due to project (socioeconomic section)
**General includes camping, picnicking, sightseeing, ect.
***Urban includes rodeos, golfing, and attending athletic events
****Water sports includes boating, swimming and water skiing
*****Winter sports includes only skiing

its present level because of the longterm impact on wildlife populations, habitat, and increased competition for licenses (see Fish and Wildlife).

Trends within impacted communities could be such that more short-term new residents than long-term (5 years) residents may occupy the region. It might be surmized that when new residents first come to the state they will not be as involved in hunting activities as those residents living in the state for a longer period of time (University of Wyoming 1976).

Although there may initially be less hunting by short-term residents, they could cause a decrease in the allowable percentage of nonresident hunting licenses (currently 23%). This may have an economic impact upon the tourist industry. Out-of-state big game hunters spent approximately $2,506,551 (not including licenses) in the ES region in 1977 (Wyoming Game and Fish Department). The nonresident and resident hunting experience also may be reduced by hunting restrictions, such as smaller hunt areas and shorter seasons, to provide maximum recreation opportunity yet maintain maximum production in big game herds and other species (Wyoming Game and Fish Department 1975).

Fishing

Fishing is the most popular recreational use within the region and accounts for the most visitor days. The fishing areas within the region are largely Seminoe Reservoir, the North Platte River, Little Snake River, mountain lakes in the Medicine Bow National Forest, and various smaller streams. Stream fishing use is projected to exceed the supply by 1985 (University of Wyoming). This factor is compounded further by the fact that over half the fishing access within the region is on private property (University of Wyoming 1976).

Reduced water quality from non-mine related accelerated erosion and sedimentation of streams could impact fishing, swimming, and other associated water recreation. It is expected that resident fishing will continue to be very popular and that nonresidents will continue to fish the area.

General Recreation

All phases of leisure related activities should increase in varying degrees.

In general, the ES region would experience an increase in the numbers of people participating in outdoor recreation. This increase would come from two sources. First, the growth in population along the front range in Colorado would cause a spillover into Wyoming. To a certain degree this is evident today. The future primary activities would probably follow very similar trends. Fishing and camping would occur during the summer. During the winter, the activities would likely include snowmobiling, ice fishing, and cross-country skiing. The present use of four-wheel drive vehicles in most of these activities would likely continue. The secondary sources of increased recreational use would come from Casper (using the northern portion of the region), southeastern Wyoming, and western Nebraska.

Recreation facilities and sites such as Seminoe State Park, Saratoga Hot Springs State Park, BLM areas (Corral Creek and Bennett Peak), and especially recreation facilities in the Medicine Bow National Forest would experience an increase in demand and be subjected to greater impacts through more visitors.

Off-Road Vehicles

The historic Overland Trail could be impacted by increased off-road vehicle (ORV) use. Other sites and areas of cultural value would also be impacted (see Cultural Resources).

Off-road vehicles are closely related to other outdoor activities within the region and most recreationists do not perceive them as a primary source of recreation, but as a tool for their activity (University of Wyoming 1976).

Approximately 36% of the region's population (families), own at least one four-wheel drive unit; however, many of these are not primarily used for recreation, but as a means of transportation.

Considering the potential population growth within the region, and the present percent of ORV ownership, it is projected that the number of ORVs in the region would increase at the same rate as the population.

Public lands which are normally available for off-road vehicle travel are particularly susceptible to destruction of vegetation and increased soil erosion. This is particularly critical on marginal soils.

On July 7, 1978, the Bureau of Land Management published in the *Federal Register* proposed rulemaking to provide for management of ORV vehicles on public lands. Concentrated ORV recreation on public lands has, in some areas, caused excessive damage to natural resources and disrupted more passive land uses. Management of ORV activities will provide for continuation of ORV recreation under conditions that will protect natural resources and other resource users and promote public safety. The regulations would establish a framework under which specific areas of the public lands could be designated as (1) open, (2) limited, or (3) closed to offroad vehicles. All public lands administered by BLM ultimately would be designated into one of these three categories of use under the proposed regulations.

Reduction in air quality from coal development and industrialization would impact the recreational sightseer. During inversion periods and high winds, visibility would be reduced, obscuring the scenic views. Additional power lines, railroad spurs, haul roads, fences, and other physical disturbances would also impact the sightseer. The possibility of additional wildfires would increase on public lands, causing additional impacts to sightseeing.

Urban Recreation

The total area presently available for parks and playgrounds is not adequate for the 1976 population, according to recommended space standards set by the National Recreation and Park Association; therefore, with the increase in population by 1990, the urban parks and recreation facilities would be highly impacted. In addition, general recreation centers/facilities and areas such as swimming pools, tennis courts, ballfields, etc., do not meet the current needs and would also be highly impacted by population growth.

Winter Sports

There may be a temporary increase in snowmobile use and purchases as more people move to the area and income increases. However, by 1985, the lack of additional suitable snowmobile areas could curb any further growth and lead to a reduction in snowmobile use. This reduction is predicted to occur between 1985 and 1990 by the Wyoming Recreation Commission.

Snowmobiling and cross-country skiing advocates would likely compete for similar areas on public lands and the Medicine Bow National Forest. Social conflicts would develop between the two groups. As these activities are managed and concentrated, additional problems would develop, e.g., litter, noise pollution, wildlife harassment, and other resource damage (University of Wyoming). Some of these impacts could be lessened by implementation of the procedures outlined under off-road vehicles.

Wilderness Areas and Potential Wilderness Study Areas

The Savage Run Wilderness Area and those roadless areas that might be designated for wilderness would be impacted by increased use by hikers, campers, and hunters.

AGRICULTURE

Livestock Grazing

The development of southcentral Wyoming coal reserves would lead to changes in land use. These changes would ultimately be at the expense of grazing lands, since grazing is the dominant use in the area.

The construction of the mines and ancillary facilities and the continuation of existing mines would result in the removal of vegetation on approximately 15,930 acres of rangeland by 1990. Acreage of vegetation that would be removed at the end of other benchmark periods would be 2,628 by 1980 and 9,993 by 1985. The disturbance of the vegetated acres would impact five ranch operators who own land and lease public lands for grazing in the project areas. The degree of impact on each ranch operation would vary greatly due to location of their individual holdings (owned and leased) in relation to the proposed development lands. Disturbance of various grazing allotments (owned and leased lands) under management of an individual ranch owner could vary from 1% to 11% of the total acreage of the allotment which would be a small part of most total average ranch operations in the region. The magnitude of the impact would also vary with the rate and timing of development of the mine. The magnitude of the impact cannot be quantified since data concerning size of ranch operations impacted are not available.

The disturbed lands would be reclaimed at the same rate as mining lands are developed. The total acreage that would be reseeded but unable to support grazing at any one time would be 8,054 acres on the proposed and existing mines. Grazing loss on this acreage would be approximately 805 animal unit months (AUMs) per year at full coal production level. This grazing loss would be sustained by one or more of the five ranches at various times during the period of active mining.

Besides direct loss of livestock forage, other impacts associated with population increases could occur. Recreation use could cause a nuisance problem (leaving gates open, molestation, etc.) and may cause temporary impairment of livestock forage use. Improved access along with increased population could result in increased vandalism of fences and other range facilities. Rustling of individual animals and the molestation of grazing animals by off-road vehicle users could develop into a serious problem, especially during calving and lambing.

Haul road dust and fugitive coal dust resulting from mining operations may be deposited on vegetation adjacent to the activity area. Dust covered vegetation would be less palatable to livestock and wildlife during the period of active mining.

Mine development could cause some loss of watering facilities for the duration of mining activities in the area. This could result in nonuse of grazing areas if their locations are remote from remaining water sources. Wells developed on specific mining sites for use in mine operations could be put to use in livestock operations when the disturbed lands are reclaimed and returned to full production.

Mine development could cause disturbance of allotment boundary and division fences. This would result in livestock control problems until the fences are replaced.

Farming

There is no cropland located within or adjacent to any of the proposed mining sites or existing mines.

The development of the Savery-Pot Hook project would result in the destruction of 366 acres of vegetation on the reservoir site, 22 acres for fence construction, and 217 acres in the construction of canals and laterals. Changes in land use would occur on 6,590 acres; 5,390 acres of sagebrush and 1,200 acres of cleared (dryland

farming) lands. This acreage would be designated full service irrigation land and would be put under intensive management for hay or crop production. More intensive management would also be initiated on 10,690 acres of presently irrigated lands through the use of supplemental irrigation water. Increased production predicted for this project would be 28,189 tons of alfalfa hay; 4,048 tons of native hay; and 302,950 bushels of grain. Livestock population would increase by 8,000 head of sheep and 12,000 head of cattle (Bureau of Reclamation).

MINERAL RESOURCES

Coal

Impact on minerals by the existing and proposed mining operations would be the removal and consumption of coal. By 1990, at least 204 million tons of coal, or about 0.38% of Wyoming's recoverable reserves of 53.3 billion tons (Glass 1976), would be mined. In underground mining, 30% to 40% of the coal is unrecoverable using present mining methods and is thus lost; 10% is estimated to be lost in surface mining operations. Losses from the proposed mines and continued operation of existing mines would total 29.9 million tons by 1990.

Uranium

There are presently no known minable reserves of uranium which would be affected by the proposed or existing mines. Some minor amounts of uranium-bearing rock could be lost during coal mining operations; however, it is expected that any significant deposits would be recognized and could be recovered in the course of coal mining operations.

Sand and Gravel

While deposits of sand and gravel are widespread across the region (see Map 12 in Appendix A), known commercially minable deposits are scarce and would be heavily utilized. Cumulative amounts of sand and gravel needed for mine facilities and housing construction are estimated to be 21,000 cubic yards by 1980; 46,000 by 1985; and 62,000 by 1990.

Scoria

Local scoria (clinker) deposits and overburden material would be used for railroad spurs and roads. Assuming 6,600 and 6,000 cubic yards per mile respectively for railroad spurs and road construction, cumulative amounts required would be 50,480 cubic yards by 1980; 148,900 cubic yards by 1985; and 289,620 cubic yards by 1990.

Assuming 10-foot thick deposits, the cumulative acres disturbed by production of sand, gravel, and scoria would be 5 by 1980, 13 by 1985, and 23 by 1990.

Oil and Gas

Coal mining could cause a temporary impact to oil and gas by delaying new exploration and production. Oil and gas exploration and development could follow coal mining and reclamation without difficulty.

SOCIOECONOMICS

Demographics

Population

Total regional population would reach 31,713 (30,892 in Carbon County and 821 in Wamsutter-Sweetwater County) by 1990 with the proposed actions. The population of Rawlins would reach 21,088 while Hanna/Elmo would reach, 2,464 (Table R4-8). The proposed federal actions would have little impact on population growth in the region between 1977 and 1980. Of the 3,601 person increase in regional population by 1980, only 161 (4.4%) would be due to the proposed actions. By 1990, the proposed actions would increase population by 1,402 persons which is 10.6% of the total increase of 13,229 persons. Rawlins would receive 81% of the increase due to the proposed actions.

Employment

The employment generated by coal development is basic, meaning that the wages earned by coal miners (and coal mine construction workers) represent a net flow of income into the region. As mine employees spend this income, they create a need for additional employment in non-basic activities such as retail trade, housing construction, and local government. In addition, employment would be generated in industries which serve the mines such as mining supply firms and electric utilities. By 1990, the 385 basic jobs created by mine development would have created a total of 612 jobs, with the non-mining jobs spread between construction, trade and services, and government (Table R4-9).

Because unemployment in the region is very low (3.0% in 1977 compared to 7.0% nationwide), there would not be sufficient "slack"in the economy to absorb the increase in mine employment that would result from the proposed actions. Mining and construction workers receive higher wages than employees in other sectors of the economy, so the new mine employment is likely to cause a shortage of workers in these other sectors. As a consequence, labor participation rates would increase as marginally productive workers (e.g., 14 to 16 year olds)

Table R4-8

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

County City	1977 Total Population	Total Without the Proposed Action	Total with the Proposed Action	Cumulative Impact	Impact of the Proposed Action
			1980		
Carbon County	18,137	21,577	21,738	3,601	161
Rawlins	10,500	13,263	13,336	2,836	73
Sinclair	550	560	562	12	2
Hanna/Elmo*	1,500	1,813	1,864	364	51
Elk Mountain	220	242	246	26	4
Medicine Bow	750	850	861	111	11
Saratoga	2,050	2,149	2,165	115	16
Encampment	500	529	533	33	4
Baggs Area**	465	465	465	0	0
Wamsutter (Sweetwater County)***	347	463	463	116	0
			1985		
Carbon County		25,903	27,167	9,030	1,264
Rawlins		16,872	17,924	7,424	1,052
Sinclair		569	613	63	44
Hanna/Elmo*		2,128	2,227	727	99
Elk Mountain		263	270	50	7
Medicine Bow		918	940	190	22
Saratoga		2,249	2,280	230	31
Encampment		556	565	65	9
Baggs Area**		465	465	0	0
Wamsutter (Sweetwater County)***		631	681	334	50
			1990		
Carbon County		29,530	30,892	12,755	1,362
Rawlins		19,959	21,088	10,588	1,129
Sinclair		576	611	61	35
Hanna/Elmo*		2,347	2,464	964	117
Elk Mountain		275	284	64	9
Medicine Bow		966	992	242	26
Saratoga		2,316	2,351	301	35
Encampment		577	588	88	11
Baggs Area**		465	465	0	0
Wamsutter (Sweetwater County)***		781	821	474	40

See notes on the following page.

Table R4-8 (Cont.)

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

Note: Cumulative impact represents the difference between total population with the proposed action and the 1977 population estimate. The impact of the proposed action is the difference between total population with the proposed action and total population without the proposed action.

*These town are located several miles apart and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

**This includes Baggs, Dixon and the unincorporated community of Savery with a population of perhaps 25.

***Population growth in Wamsutter results from uranium mining activity in the Red Desert area. Energy projects to the west of Wamsutter (in the Rock Springs area) may result in additional growth in Wamsutter's population beyond the estimates shown here.

Source: Water Resources Research Institute Economic Simulation Model University of Wyoming Water Resources Research Institute, Laramie, 1978. Region-wide totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

Table R4-9

SOUTHCENTRAL WYOMING EMPLOYMENT

Sector*	1977 Total Employment	Total Without the Proposed Action	Total With the Proposed Action	Cumulative Impact	Impact of the Proposed Action
			1980		
Mining	1,658	2,362	2,487	829	+125
Construction	715	1,054	1,058	343	+4
Business Services	1,415	1,589	1,566	151	-23
Consumer Services	1,948	2,102	2,082	134	-20
Government	919	1,018	1,004	85	-14
Total	8,067	9,623	9,695	1,628	+72
			1985		
Mining		2,802	3,212	1,554	+410
Construction		1,132	1,321	606	+189
Business Services		2,005	1,998	583	-7
Consumer Services		2,476	2,478	530	+2
Government		1,419	1,422	503	+3
Total		11,514	12,111	4,044	+597
			1990		
Mining		2,728	3,113	1,455	+385
Construction		1,488	1,518	803	+30
Business Services		2,433	2,485	1,070	+52
Consumer Services		2,877	2,956	1,008	+79
Government		1,754	1,820	901	+66
Total		13,102	13,714	5,647	+612

Note: Cumulative impact represents the difference between total employment with the proposed action and the 1977 employment estimate. The impact of the proposed action is the difference between total employment with the proposed action and total employment without the proposed action.

* Only those sectors affected by increased mining activity are shown.

Source: Water Resources Research Institute Economic Simulation Model, Water Resources Research Institute, Laramie, 1978.

would be hired to partially relieve the shortage, and unemployment rates would remain low. Eventually, the low unemployment rate would lead to in-migration of workers to fill the available jobs. In 1980, the mines would employ 145 workers (including 20 construction workers), yet there would be a net employment increase of only 72 workers. The proposed actions would therefore draw 73 workers out of other sectors in the economy. (The employment in these sectors would not actually decline; rather employment would increase less than without the proposed actions.) In 1985, the mines would employ 610 workers and the net employment increase would be 597, indicating that 16 workers would be drawn out of other sectors of the economy. By 1990, the economy would have adjusted to the employment increase and there would be total additional employment of 612 resulting from additional mining employment of 385, a total additional employment to additional mining employment ratio of 1.59 (Centaur 1978).

Agriculture (although not represented in Table R4-9) would be one of the affected sectors of the economy as competition for labor becomes severe. In a report by F. L. Leistritz and T. A. Hertsgaard, it was shown that when industry (coal development) moves into a rural area, farm and ranch operators are faced with the necessity of offering higher wages or reorganizing their farms or both. Operators of small farms and ranches who have been underemployed in their farm or ranch business may take advantage of the new off-farm job opportunities that coal development provides.

Operators who are fully employed with adequate incomes from agriculture and who do not hire much extra labor would be least affected by increased competition for labor. Those operating large farms and ranches requiring large amounts of labor would be likely to make significant adjustments in their operations. These adjustments would likely include dropping certain labor-intensive enterprises, adopting labor-saving technologies, and perhaps even reducing the size of their operation.

Income

Between 1977 and 1990, total personal income in the region would rise from $147.1 million to $394.4 million. Of this, $22.1 million would be due to the proposed actions. Wage and salary income would increase $13.6 million, an average of $22,200 for each additional worker resulting from the proposed actions (Table R4-10). The increase in the number of higher-paid workers is also reflected in per capita income, which would be $12,800 in 1990 with the proposed actions and $12,600 without them (Centaur 1978).

This increase in income would create local inflationary pressures. This is because the miners and mine-related employees have more money to spend on goods and services than do others. This affects those on fixed incomes (retirees, welfare recipients, etc.) more than anyone else. As incomes and prices rise rapidly, their incomes do not. This reduces their buying power.

Infrastructure

Private Sector

The increase in personal income in the region that would result from the proposed actions would generate additional sales in retail trade and services. With the proposed actions, the total 1980 sales would be $85.5 million (in constant 1977 dollars). This would be a 38% increase over the 1977 total, 5% of which would be due to the proposed actions. By 1990 sales would be $165.6 million (constant 1977 dollars). This would be a 168% increase over 1977 sales. About 9% of these sales would be due to the proposed actions (Centaur 1978).

Rawlins would be expected to have the largest increase in sales because of its role as the major retail trade center in Carbon County and because the largest proportion of the county's additional population (81%) is expected to live there.

Along with these increased sales there would be a diversification of business types to take advantage of the new sales opportunities. New businesses would locate in the region that have not been represented in the local economy previously.

Local Government

County government expenditures in Wyoming average $221 per capita compared to revenues of between $635 and $668 (U.S. Department of Agriculture 1978). Little capital investment would be needed to provide services to new residents (a new hospital was built in 1972; no other major investments are planned) and the county is expected to benefit from additional coal development.

Per capita expenditures in the region's communities range between $200 and $275 (in Rawlins they are $273). This compares to a statewide average of $235 per capita. Per capita revenues for new residents in Wyoming communities average between $73 and $87 (U.S. Department of Agriculture 1978). Local government revenues come from a variety of sources, including property tax collections, water/sewer user fees, and various taxes (e.g., sales tax) "passed back"from the state or county. Local communities have no direct taxing authority over the new coal mines (which are located beyond the city limits), so revenue increases associated with new coal mining would be limited to those collected from new community residents. This could lead to expenditure/revenue deficits of from $113 to $202 per new resident in the region. These figures do not take into account two complicating factors: (1) the number of businesses in a community may increase as population increases, raising assessed value and thus property taxes; and (2) many of the taxes "passed back"by the state and county are fixed (i.e., do not vary with population) in the short run because allocation formulas are based on the latest available U.S. decennial census. Thus it appears that the region's communities may face financial problems as their population grows due to coal development.

Table R4-10

SOUTHCENTRAL WYOMING PERSONAL INCOME
(thousands of constant 1977 dollars)

Sector*	1977 Total Personal Income	Total Without the Proposed Action	Total With the Proposed Action	Cumulative Impact	Impact of the Proposed Action
			1980		
Mining	25,944	40,976	43,140	17,196	+2,164
Construction	12,291	19,496	19,568	7,277	+72
Business Services	17,934	22,355	22,036	4,102	-319
Consumer Services	12,280	14,206	14,070	1,790	-136
Government	11,005	13,292	13,115	2,110	-177
Total Wage and Salary Income	91,196	124,241	125,845	34,649	+1,604
Total Personal Income**	147,094	200,949	203,548	56,454	+2,599
			1985		
Mining		57,761	66,202	40,258	+8,441
Construction		23,641	27,595	15,304	+3,954
Business Services		33,563	33,449	15,515	-114
Consumer Services		18,781	18,790	6,510	+9
Government		21,345	21,385	10,380	+40
Total Wage and Salary Income		173,900	186,230	95,034	+12,330
Total Personal Income**		281,899	301,921	154,827	+20,022
			1990		
Mining		66,867	76,901	50,957	+10,034
Construction		35,099	35,812	23,521	+713
Business Services		48,453	49,502	31,568	+1,049
Consumer Services		24,494	25,162	12,882	+668
Government		30,506	31,627	20,622	+1,121
Total Wage and Salary Income		229,406	242,991	151,795	+13,586
Total Personal Income**		372,325	394,397	247,300	+22,072

(continued)

Table R4-10 (Cont.)

SOUTHCENTRAL WYOMING PERSONAL INCOME
(thousands of constant 1977 dollars)

Note: Cumulative impact represents the difference between personal income with the proposed action and the 1977 personal income estimate. The impact of the proposed action is the difference between personal income with the proposed action and personal income without the proposed action.

* Only those sectors in which changes occur as a result of the proposed action are shown .

** In addition to wage and salary income this includes agricultural salary income, proprietors' income, other labor income (such as employer pension contributions) and other income (such as government transfer payments).

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, 1978. The model's estimates are in constant 1973 dollars which were adjusted to constant 1977 dollars using the Western State Consumer Price Index (U.S. Bureau of Labor Statistics). Proprietors' income was adjusted using data from the Bureau of Economic Analysis, Local Area Personal Income: 1970-1975, to reflect recent trends in Carbon County.

Housing

Energy and construction workers are much more able to pay for housing than other workers in the region (Table R4-11). As total housing demand rises from 6,697 housing units in 1977 to 11,565 units in 1990 (716 of which would be due to the proposed actions) (T able R4-12) housing would become even more expensive, available housing would become more crowded, and people would have to accept housing which is not the type they desire. Mobile homes would rise from 25% of the total 1977 housing demand to 34% of the total housing demand in 1990.

Education

Projected school age population for the two Carbon County school districts is shown on Table R4-13. Between 1977 and 1990, school age population in School District No. 1 would increase from 3,292 to 6,554, with 9.3% of the increase due to the proposed actions. In the same time period, school age population in School District No. 2 would increase from 1,646 to 2,145, with 8.4% of the increase due to the proposed actions.

Capacity in School District No. 1 is adequate to meet present need, but would be exceeded by 1980. This would occur with or without the proposed actions. A new junior high school (now under construction) in Rawlins with a capacity of 850 and a planned elementary school (expected capacity: 300 to 400) would increase capacity to meet projected needs in 1980 and through about 1984. By 1985, school age population with the proposed actions would reach 5,521 (18% of which would be due to the proposed actions). Thus, the district would need to continue to maintain an active expansion program in order to keep up with projected increases.

Considerable staffing increases would be necessary in the very near future, particularly at the elementary grade levels. Specifically, staffing increases of 77 would be required by 1980, an additional 75 by 1985, and another 54 by 1990 (a total increase of 206 teachers) to maintain the current student/teacher ratio of 18.8. Only 16 of these (7.7%) would be directly attributable to the proposed actions.

School District No. 2 would experience less significant enrollment impact as a result of the proposed actions. The district currently has sufficient building capacity to meet projected needs through 1990. Some staffing increases would be required to maintain the 1977 student/teacher ratio of 15.7. Staffing increases of 11 would be required by 1980, an additional 12 by 1985, and another 9 by 1990 (a total increase of 32 teachers). Only 3 of these (9.4%) would be directly attributable to the proposed actions.

Health Care and Safety

By 1990 there would be a need for an additional 22 physicians, 39 registered nurses, and 12 dentists. However, only 1 physician, 4 nurses, and 1 dentist would be required as a result of the proposed actions (Table R4-14).

The Memorial Hospital in Rawlins presently has capacity for a population of about 29,000 to 33,000, compared to Carbon County's 1977 population of 18,137. Even with the additional 1,402 people that would come into the region as a result of the proposed actions, the hospital would still have excess capacity (total regional population would be 31,713 by 1990).

In 1974, the incidence of work-related injury or illness in Wyoming for all industries was 10.4 cases per 100 full-time workers. (This is the same incidence rate as for the United States as a whole—U.S. Department of Labor 1976.) Bituminous coal mining in Wyoming appears much safer than the average industry, with 5.2 cases of injury or illness per 100 full-time workers. (For the United States, the incidence rate for bituminous coal mining is 10.6 cases per 100 full-time workers. Anthracite mining, primarily in underground mines, is much more dangerous with an incidence rate of 22.3 cases per 100 full-time workers.) If the incidence rate for injury and illness in bituminous coal mining holds in the future, the additional coal mining at the three proposed mines would increase injury and illness by an average of 20.0 cases per year in Wyoming. An unquantifiable number of these would be fatal or debilitating. Because bituminous coal mining appears safer than the average industry, this increase in injury and illness is likely less than would be expected from employment increases in other sectors of the economy.

Local Services

Total needs for local services (due to the proposed actions) would not be significant for the communities in the region. Increased needs for services (fire, police, sewer, water) due to the cumulative impact of all activities in the region (coal, uranium, oil and gas, construction projects, etc.) would be very significant for some communities, primarily Rawlins (Tables R4-15, R4-16, R4-17, and R4-18).

Transportation and Utilities

The proposed actions would require no new public roads. Access roads from the highway into the mine sites would be built by the mining operators and would be used for mining activities only. Increases in round trip road travel due to commuting to and from the mining areas would create some congestion. This would be temporary, near the mine sites, and would be expected at the time of shift changes. The traffic generated as a result of the proposed actions would not be expected to adversely affect the carrying capacity of the roads.

Accidents would be expected to increase as traffic increases. Several factors such as type of road, speed, weather, and adjacent land uses affect the number and severity of accidents (Soloman 1978). A projection of the number of accidents that could be expected is not possible because total additional traffic, including traffic passing through the region from origins and destinations outside of it, is not known.

Table R4-11

ABILITY OF CONSUMERS TO PAY FOR NEW HOUSING

Type of Worker Type of Unit	1977 Estimated Monthly Cost	1977 Percent of Monthly Income****
Construction/Manufacturing Workers		
Single Family	372-390*	28-35
Multiple Family	250-330**	23-30
Mobile Home	218-303***	20-27
Energy Industry Workers		
Single Family	312-390*	18-23
Multiple Family	250-330**	15-20
Mobile Home	218-303***	13-18
Other Workers		
Single Family	312-390*	38-77
Multiple Family	250-330**	30-66
Mobile Home	218-303***	25-60

* Calculations were based on a purchase price of $48,000-$60,000. Financing terms were assumed to be 20 percent down with the balance mortgaged at 9-1/8 percent for 30 years.

** Includes utilities.

*** Calculations were based on a purchase price of $15,000-$25,000. Financing terms were assumed to be 25 percent down with the balance mortgaged at 11 percent for 15 years. An additional expense of $90 for rental of a mobile home site was included in the estimated monthly cost.

**** Average monthly income is $1,106 for construction workers, $1,690 for mine workers and between $503 and $830 for other workers.

Sources: Mr. Anderson, President, Westland Federal Savings and Loan, telephone conversation in May 1978.

Dick Gillilan, Hi Country Home, telephone conversation in May 1978.

Steven Dudley, Jebens Mobile Homes, telephone conversation in May 1978.

Wyoming Employment Security Commission, Average Weekly Wage By Industrial Sector, 1977 (January-June).

Table R4-12

SOUTHCENTRAL WYOMING HOUSING DEMAND

Type of Housing	1977 Total Housing Demand	Total Without the Proposed Action	Total With the Proposed Action	Cumulative Impact	Impact of the Proposed Action
		1980			
Single Family Homes	4,420	5,266	5,337	917	71
Multiple Family Units	536	605	623	87	18
Mobile Homes	1,741	2,090	2,109	368	19
Total Housing Demand	6,697	7,961	8,069	1,372	108
		1985			
Single Family Homes		6,024	6,349	1,929	325
Multiple Family Units		682	755	219	73
Mobile Homes		2,822	2,969	1,228	147
Total Housing Demand		9,528	10,073	3,376	545
		1990			
Single Family Homes		6,287	6,800	2,380	513
Multiple Family Units		702	771	235	69
Mobile Homes		3,860	3,994	2,253	134
Total Housing Demand		10,849	11,565	4,868	716

Note: Cumulative impact represents the difference between total housing demand with the proposed action and the 1977 housing estimates. The impact of the proposed action is the difference between housing demand with the proposed action and housing demand without the proposed action.

Source: Calculated based on housing preference and the ability of study area families to afford the various types of available housing.

Table R4-13

SOUTHCENTRAL WYOMING SCHOOL-AGE POPULATION

School District	1977 Population	Total Without the Proposed Action	Total With the Proposed Action	Cumulative Impact	Impact of the Proposed Action
		1980			
District #1					
Population	12,322	15,315	15,390	3,068	75
School-Age Population	3,292	4,109	4,120	828	11
District #2					
Population	6,162	6,725	6,811	649	86
School-Age Population	1,646	1,804	1,824	178	20
		1985			
District #1					
Population		19,248	20,424	8,102	1,176
School-Age Population		5,250	5,521	2,229	271
District #2					
Population		7,256	7,424	1,262	168
School-Age Population		1,979	2,007	361	28
		1990			
District #1					
Population		22,658	23,892	11,570	1,234
School-Age Population		6,249	6,554	3,262	305
District #2					
Population		7,623	7,821	1,659	198
School-Age Population		2,103	2,145	499	42

Note: Cumulative impact represents the difference between total population with the proposed action and the 1977 population estimate. The impact of the proposed action is the difference between total population with the proposed action and total population without the proposed action.

Sources: Water Resources Research Institute Economic Simulation Model, University of Wyoming Water Resources Research Institute, Laramie, 1978. School-age population estimated from age-specific population projections.

Wyoming State Highway Commission, 1977 Wyoming Highway Map, Cheyenne, 1977. This source gives population estimates for unincorporated communities which are used in estimating 1977 school district population.

Table R4-14

HEALTH CARE SPECIALIST NEEDS
(number of health care specialists)

Health Care Specialist	1977 Number	Total Without the Proposed Action	Total with the Proposed Action	Cumulative Impact	Impact of the Proposed Action
			1980		
Physicans	9	22	22	13	0
Registered Nurses	69	76	76	7	0
Dentists	7	13	14	7	1
Professional Mental Health Counselors	3	5	5	2	0
			1985		
Physicians		26	27	18	1
Registered Nurses		91	95	26	4
Dentists		16	17	10	1
Professional Mental Health Counselors		6	7	0	1
			1990		
Physicans		30	31	22	1
Registered Nurses		104	108	39	4
Dentists		18	19	12	1
Professional Mental Health Counselors		7	8	5	1

Note: Cumulative impact represents the difference between total specialists with the proposed action and the 1977 number of specialists. The impact of the proposed action is the difference between total with the proposed action and total without the proposed action.

* This is the number of health care specialists in Carbon County. Based on standards of 1,000 population per physician, 285 population per registered nurse, 4,000 population per professional counselor and 1,600 population per dentist, the numbers of physicians, counselors, and dentists are inadequate. An adequate level of specialists would be 18 physicians, 64 registered nurses, 5 professional counselors, and 11 dentists.

Source: Standards for the number of health care specialists are identified in Wyoming Health Profiles 1976, Wyoming Department of Health and Social services. The recommended standard for professional counselors was provided by the Director of the Carbon County Mental Health Center.

Table R4-15

POLICE SERVICE NEEDS DUE TO THE PROPOSED ACTION
(full-time officers required)

Community	1977 Full-time Officers*	Total Without the Proposed Action	Total With the Proposed Action	Cumulative Action	Impact of the Proposed Action
			1980		
Rawlins	18	23	23	5	**
Sinclair***	2****	1(2)	1(2)	--**	**
Hanna/Elmo	2	4	4	1	--**
Medicine Bow	1	2	2	--**	--**
Saratoga	5	5	5	--**	--**
Encampment	0*****	1	1	--**	--**
Wamsutter	1	1	1	--**	0
			1985		
Rawlins		29	30	13	2
Sinclair		1(2)	1(2)	--**	--**
Hanna/Elmo		4	5	1	--**
Medicine Bow		2	2	--**	--**
Saratoga		5	5	--**	--**
Encampment		1	1	--**	--**
Wamsutter		2	2	1	--**
			1990		
Rawlins		34	36	18	2
Sinclair		1(2)	1(2)	--**	--**
Hanna/Elmo		5	5	2	--**
Medicine Bow		2	2	--**	--**
Saratoga		5	5	--**	--**
Encampment		1	1	--**	--**
Wamsutter		2	2	1	--**

Note: Cumulative impact represents the difference between full-time officers with the proposed action and the 1977 full-time action estimate. The impact of the proposed action is the difference between full-time officers with the proposed action and full-time action without the proposed action.

* This is the actual number of officers.

** Less than one full-time officer would be needed.

*** Current service is rated high based upon Wyoming and national criteria, Capital Facilities Study, p. 932. The numbers in parenthesis are based upon continued high level service. The other number is based upon an adequate level of service.

**** There are two part-time officers as well.

***** There is one part-time officer.

Table R4-16

WATER DEMAND DUE TO THE PROPOSED ACTION
(maximum daily usage requirements)

Community	1978 Supply Capacity*	Total Without the Proposed Action	Total with the Proposed Action	Cumulative Impact	Impact of the Proposed Action
			1980		
Rawlins	5.0	6.0 (20%)	6.0 (20%)	1.3	.03
Sinclair	2.6	2.7 (4%)	2.7 (4%)	.005	.001
Hanna/Elmo	.675	.816 (21%)	.839 (24%)	.164	.023
Elk Mountain	.027**	.030 (11%)	.030 (11%)	.003	0
Medicine Bow	.338***	.383 (13%)	.388 (15%)	.050	.005
Saratoga	1.08	.967	.974	.052	.007
Encampment	.225***	.238 (6%)	.240 (7%)	.015	.002
Wamsutter	.156***	.208 (33%)	.208 (33%)	.052	0
			1985		
Rawlins		7.6 (52%)	8.1 (62%)	3.3	.500
Sinclair		2.7 (4%)	2.9 (12%)	.028	.020
Hanna/Elmo		.958 (42%)	1.0 (48%)	.327	.045
Elk Mountain		.032 (19%)	.033 (22%)	.006	0
Medicine Bow		.413 (22%)	.423 (25%)	.086	.010
Saratoga		1.0	1.0	.104	.014
Encampment		.250 (11%)	.254 (13%)	.029	.004
Wamsutter		.284 (82%)	.307 (97%)	.150	.023
			1990		
Rawlins		9.0 (80%)	9.5 (90%)	4.8	.500
Sinclair		2.7 (4%)	2.9 (12%)	.028	.016
Hanna/Elmo		1.1 (63%)	1.1 (63%)	.434	.053
Elk Mountain		.034 (26%)	.035 (30%)	.008	.001
Medicine Bow		.435 (29%)	.446 (32%)	.109	.012
Saratoga		1.0	1.1 (2%)	.136	.016
Encampment		.260 (16%)	.265 (18%)	.040	.005
Wamsutter		.352 (126%)	.370 (137%)	.213	.018

Note: Cumulative impact represents the difference between supply capacity with the proposed action and the 1977 supply capacity estimate. The impact of the proposed action is the difference between supply capacity with the proposed action and supply capacity without the proposed action. The figures may not add due to the rounding.

*Quantities relate to millions of gallons per day.

**Elk Mountain residents have an extremely low water usage of 123 gallons per capita per day. (According to Jim Beed, Banner Associates, now conducting an engineering study of the water system for Elk Mountain.) It is not known how the average daily usage would change as a result of of an influx of new residents into Elk Mountain.

***1977 supply capacity not reported but community reports it is meeting current demand. Current capacity based on Wyoming state planning standard of 450 gallons per day per capita peak usage.

Table R4-17

SEWAGE TREATMENT DEMAND DUE TO THE PROPOSED ACTION

Community	1977 Capacity*	Total Without the Proposed Action	Total with the Proposed Action	Cumulative Impact	Impact of the Proposed Action
			1980		
Rawlins	30 (250%)	132.6 (342%)	133.4 (345%)	28.0	.7
Sinclair	**	5.6	5.5	0.1	0.0
Hanna/Elmo	22.2	18.1	18.6	3.6	0.5
Medicine Bow	37	8.5	8.6	1.1	0.1
Saratoga	2.9 (607%)	21.5 (641%)	21.6 (645%)	1.2	0.2
Encampment	2 (150%)	5.3 (165%)	5.3 (165%)	0.3	0.0
Wamsutter	2.7 (30%)	4.6 (70%)	4.6 (70%)	1.2	0.0
			1985		
Rawlins		168.7 (462%)	179.2 (479%)	74.2	10.5
Sinclair		5.7	6.1	0.6	0.4
Hanna/Elmo		21.3	22.3 (.4%)	7.3	1.0
Medicine Bow		9.2	9.4	1.9	0.2
Saratoga		22.5 (676%)	22.8 (686%)	2.3	0.3
Encampment		5.6 (180%)	5.6 (180%)	0.6	0.0
Wamsutter		6.3 (133%)	6.8 (152%)	3.3	.5
			1990		
Rawlins		199.6 (565%)	210.9 (603%)	105.1	11.3
Sinclair		5.8	6.1	0.6	0.4
Hanna/Elmo		23.5 (6%)	24.6 (11%)	9.6	1.2
Medicine Bow		9.7	9.9	2.4	0.3
Saratoga		23.2 (700%)	23.5 (710%)	3.0	0.4
Encampment		5.8 (190%)	5.9 (195%)	0.9	0.1
Wamsutter		7.8 (189%)	8.2 (204%)	4.7	0.4

See notes on the following page.

Table R4-17 (Cont.)

SEWAGE TREATMENT DEMAND DUE TO THE PROPOSED ACTION

Note: Cumulative impact represents the difference between sewage capacity with the proposed action and the 1977 sewage capacity. The impact of the proposed action is the difference between sewage capacity with the proposed action and sewage capacity without the proposed action. The figures may not add due to rounding.

*All numbers relate to lagoon acres based on a standard of .01 lagoon acres per capita; Rawlins, Saratoga and Encampment are above capacity, Sinclair and Wamsutter are at capacity, and Hanna/Elmo and Medicine Bow have excess capacity.

**Sinclair has two Imhoff tanks. According to the Wyoming Environmental Quality office, this system is outdated and overloaded. Sinclair will most likely convert to a lagoon system by 1983. Future projections are based on lagoon standards.

Source: Estimates based upon Wyoming State Engineers Office planning standard of .01 lagoon acres per capita.

Table R4-18

COMMUNITY FIREFLOW NEEDS

Community	1978 Capacity	1978 Demand	1980 Total With the Proposed Action	1980 Impact of the Proposed Action	1985 Total With the Proposed Action	1985 Impact of the Proposed Action	1990 Total With the Proposed Action	1990 Impact of the Proposed Action
Rawlins	4,250	3,000	3,500	**	4,100	100	4,400	100
Sinclair	1,250	500	600	**	600	**	600	**
Hanna/Elmo	1,450*	1,250	1,500	**	1,550	**	1,600	**
Elk Mountain	N.A.	500	500	**	500	**	500	**
Medicine Bow	500	750	850	**	925	**	975	**
Saratoga	950	1,500	1,550	**	1,575	**	1,600	**
Encampment	N.A.	500	500	0	550	**	575	**
Wamsutter	N.A.	500	500	0	700	**	800	**

Note: Numbers refer to pumping capacity (gpm, gallons per minute pumped).

* Hanna/Elmo has an additional 500 gpm supplement available from the county.

**less than 100 GPM required.

Source: Based on community population estimates and fireflow standards from Economic/Demographic Assessment Manual, U.S. Department of the Interior, Bureau of Reclamation, 1977.

No change in the types of passenger transportation currently available would be expected as a result of the proposed actions.

The increase in unit coal trains originating from the proposed actions would not cause serious adverse impacts in the larger southcentral and southeastern Wyoming communities along the Union Pacific main line. Due to the accessibility of grade separations (i.e., overpasses or underpasses), residents in the more densely populated areas of Rawlins, Laramie, and Cheyenne would be able to circumvent train traffic and thus avoid vehicle and pedestrian delays. Two smaller communities, Rock River in Albany County and Pine Bluffs in Laramie County, would need grade separations to handle the anticipated future train volume. Other adverse impacts such as physical separation of parts of town or noise and air pollution would occur to a greater degree; however, local community officials do not expect these impacts to be severe (Nelson 1978; Hawes 1978; Grunkemeyer 1978; Ivanson 1978).

In Nebraska, the increase in rail traffic from the proposed actions would aggravate an already serious vehicle and pedestrian transit problem. Currently, rail traffic causes delays and inconveniences in a number of Nebraska communities. The projected increase even without the proposed actions would place a severe burden on the communities of Sidney and Grand Island, Nebraska, and Julesburg, Colorado if grade separations are not constructed.

The projected increase of approximately 3 unit trains per day would be insignificant when compared to the projected total freight traffic of 67 and 73 trains per day in 1985 and 1990 respectively (Figure R4-2). However, this increase would add to problems of pedestrian and vehicle access routes, isolation of parts of town, and safety hazards in communities where they are already occurring. The communities of Julesburg, Colorado and Sidney and Grand Island, Nebraska would experience the most serious impacts (Map R4-8).

Julesburg is affected by rail traffic moving south towards Denver on a Union Pacific main line as well as east towards Grand Island. By 1990, railroad crossings in this community would be blocked between 4 3/4 to 7 3/4 hours per day depending on the train speed. Approximately 15 minutes of this time would be due to coal trains from the proposed actions. Since no grade separations or pedestrian overpasses are available in the community, a serious transit problem would occur.

Sidney is concerned about the safety of the 30 to 35 children who cross over the railroad tracks on their way to and from school. Unless some corrective measures (e.g., a proposed pedestrian overpass) are taken during the intervening years, additional train traffic would increase the probability of injury to these children.

Impacts in Grand Island arise from the combined southcentral Wyoming and Powder River Basin freight traffic. (Traffic from these areas enters Grand Island along two separate main lines which cross in the center of town.) Unless a solution to alleviate traffic congestion at the intersection of these two rail lines is agreed upon, serious problems would be anticipated. Emergency vehicles and school buses, already experiencing significant delays, would be blocked at crossings for even longer periods of time. Additionally, access to the Hall County Airport in the northeast section of town would be a problem.

Based on railroad travel capacity figures of about 70 to 80 trains daily, the projected train volume would not necessitate additional track expansion.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the proposed actions as a further aggravation of their position. In spite of the benefits (employment and income), they would resent the increased population and urbanization that would occur, even though increases would be slight due to the proposed actions (see Population). Those persons who would benefit from the actions directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages. Their positions would advance financially, and they would see the mines as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mines could see it further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining section (Abt Associates 1977; Gilmore 1974).

Lifestyles

The changes currently occurring in the lifestyles of Carbon County residents (see Chapter 2, Lifestyles) would continue with or without the proposed actions. They would reinforce and possibly speed up those changes in the impacted portions of the region. The magnitude of the impact that would be due to the proposed actions is not quantifiable.

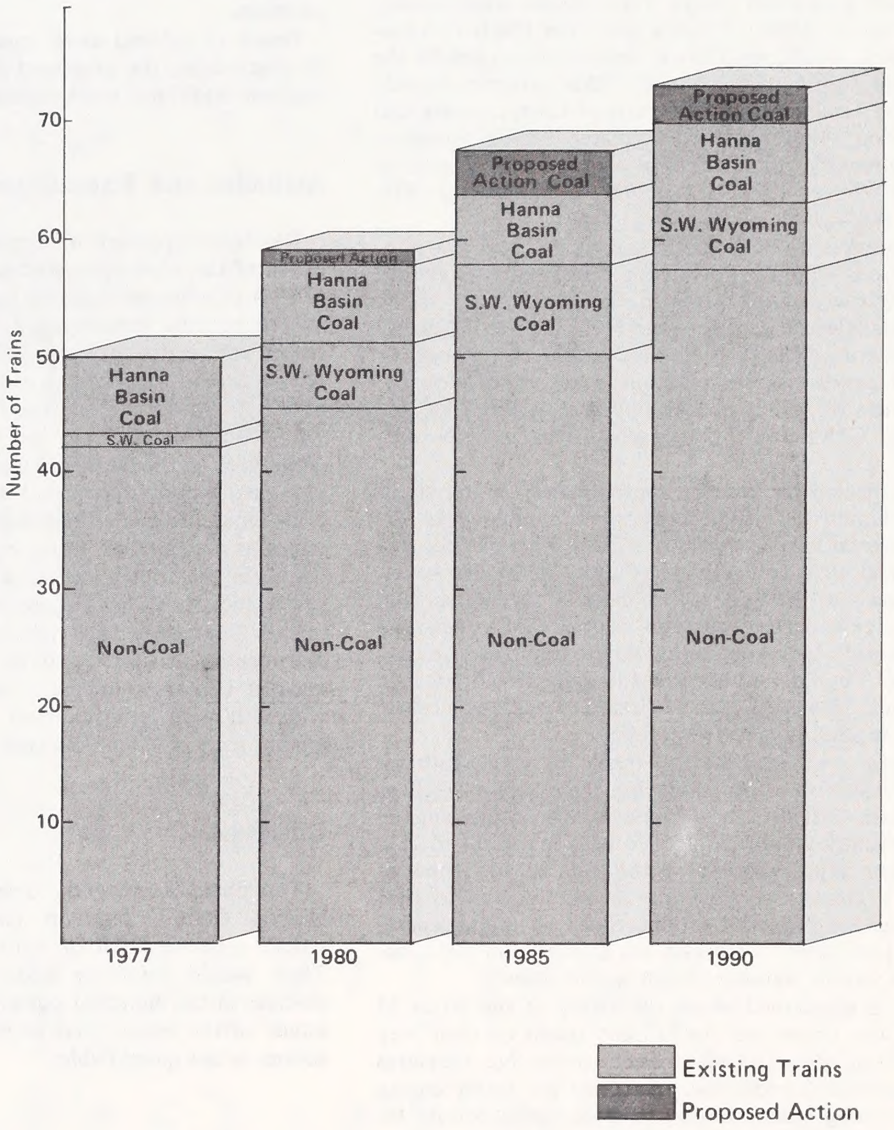
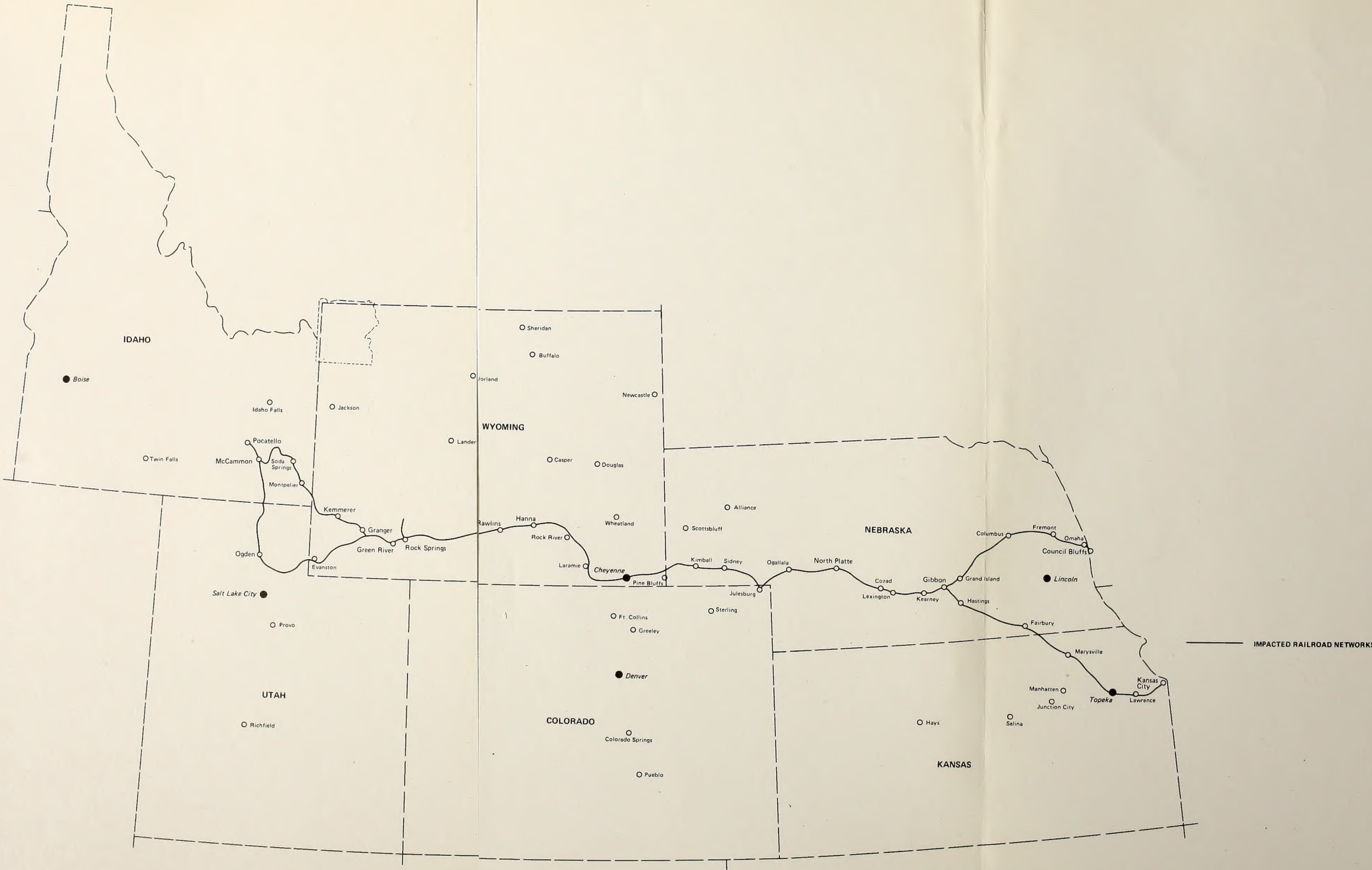


Figure R4-2

DAILY TRAIN TRAFFIC



R4-51

Map R4 - 8
TRAIN TRAFFIC

CHAPTER 5

ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSED ACTIONS BE IMPLEMENTED

This chapter lists and quantifies adverse impacts upon the environment that would be due to implementation of the proposed actions. This implementation would not cause significant or adverse impacts to all resources. Therefore, only those resource elements that would be adversely impacted are discussed in this chapter.

The proposed actions may change the surface meteorology at the mine sites by alternating the surface contours, albedo and material distribution, and temporarily reducing vegetation during mining.

The proposed action coal cannot be surface mined without generating fugitive dust. The three proposed actions would not cause the regional air quality to deteriorate. However, within and at the boundary of the individual mines, the Class II PSD increments and Wyoming air quality standards for total suspended particulates (TSP) would be exceeded. Beyond 6 miles of the individual mines, the annual TSP concentrations are predicted to be less than 1 microgram per cubic meter ($\mu g/m^3$) above the baseline concentrations.

The Hanna South Mine while in operation is predicted to cause the Wyoming air quality standards to be exceeded at the edge of Hanna. Applying best management practices as outlined in the Hanna South site specific, Chapter 8, would reduce this impact to comply with current Wyoming air quality standards. Within a few square miles of a remote area, the Cherokee Mine would cause ambient annual TSP concentrations of greater than 100 $\mu g/m^3$ well above the Wyoming air quality standard of 60 $\mu g/m^3$. If fugitive dust emissions are excluded from contributing to the PSD increments (43 CFR 118), the proposed actions would not cause the Class II increments to be exceeded.

The mean annual visibility related to atmospheric particulates would remain unchanged at 47 miles in the region as a whole if the proposed actions were implemented. The most noticeable reductions of visibility would occur at the southern edge of Hanna near the Hanna South Mine. The mean annual visibility in Hanna near the Hanna South Mine would be about 17 miles. During days having the highest predicted 24-hour TSP concentrations, the visibility would be reduced to 14 miles. The mean annual visibility would be 13 miles within a few miles east of the Cherokee Mine, while the visibilities during the days with the highest predicted 24-hour particulate concentration at the mine would be 4 miles. The Seminoe I Mine amendment would lengthen the life of the Seminoe I Mine. Hence, the mine amendment would prolong the period in which the TSP concentrations would be increased and the visibilities would be reduced from baseline conditions at the mine site.

Droughts would cause a slight increase in the area around the proposed actions affected by particulate emissions from the mines as compared to normal precipitation conditions.

Small decreases of the visibilities would occur near the boundaries of the proposed actions during dry conditions.

Coal fires can be a significant source of air pollution in the ES region. However, the impact of coal fires on regional air quality is unquantifiable.

Unavoidable destruction, disturbance, and removal of paleontological resource, both exposed and unexposed, would occur.

In the areas to be disturbed by surface mining and related activities, soil profiles and properties that have developed over geologic time would be altered on 5,904 acres (approximately 0.1% of the region) by 1990. The existing soil biota and soil forming processes would be drastically altered. Conventional surface strip mining would destroy approximately 384 acres a year, with an additional 1,299 acres of disturbance from related activities by 1990.

The mining activities would cause losses in soil productivity and increased soil erosional losses (refer to Chapter 4, Regional). The soil productivity losses would occur from the time of disturbance until reclamation is successful, about 10 to 15 years after reclamation efforts began. The increases in population associated with coal development as well as other population growth would cause surface soil damages (erosion) due to off-road vehicle (ORV) usage. This damage would occur along roads, trails, and high use (ORV) areas. The extent of this surface damage in unrestricted and uncontrolled areas is unquantifiable.

The only significant regional impact on water resources would be the increase in water use. Municipal use in 1990 would be 260 acre feet per year (ac ft/yr) greater with the proposed mines than it would be with no federal action, and industrial use would be 650 ac ft/yr greater (see Figure R4-1). These figures represent increases of 5% and 47% respectively. The total amount of water used in the region would increase by 0.3%; water quality changes would be insignificant.

Mine pits and settling basins would interrupt less than 50 ac ft/yr each from groundwater aquifers and ephemeral streams. Flood control reservoirs at Hanna South

would interrupt about 200 ac ft/yr. Impacts would be negligible.

By 1990, vegetation on 5,560 acres (0.1% of the region) would be disturbed by the development of the proposed coal projects. Full vegetative productivity on these disturbed acres is expected with successful reclamation. The loss of native vegetation (primarily sagebrush-grass type) on 344 acres would be permanent since the acreage would be utilized as housing and service facility sites at various population centers.

An indeterminate acreage of vegetation would be disturbed through the indiscriminate use of four-wheel drive vehicles. This loss would increase with the increase in population and cannot be avoided on areas where the damage sustained does not warrant restricted use or closure.

Since lightning fires cannot be prevented, and fire prevention measures are not 100% effective, an unavoidable loss of vegetation will occur. It is estimated that the annual acreage of vegetation lost to fire in the region could be 1,414 by 1980; 1,490 by 1985; and 1,567 by 1990. The periodic increase is the result of increased outdoor activities by the expanded population.

Human activities in all areas of the region would increase because of increased population. These increased human activities would impact many species of animals through harrassment, poaching, wanton destruction, and automobile/animal collisions. These losses could not be avoided.

Habitat for many wildlife species would be lost on 5,560 acres by 1990 as a direct result of the proposed actions. Existing mines and other energy related developments will also remove an additional 12,856 acres of wildlife habitat by 1990 (see Table R4-6). The proposed actions and the other regional developments would also permanently take 344 acres out of available wildlife habitat because of housing developments associated with mine employment. Wildlife habitat lost would make up less than 1% of habitat within the region. These losses could not be avoided.

Actual, direct losses of wildlife due to the proposed mines are not quantifiable for most species because of a lack of good population dynamics data. Losses of pronghorns and sage grouse can be extrapolated because good data are available and computer simulation techniques are available to make these projections. Losses to pronghorns due to the proposed actions would total 397 animals by 1985 and 1,830 by 1990. These losses would not be significant when compared to the estimated regional population of 44,000 animals. Sage grouse losses would be 60 birds by 1980; 1,274 birds by 1985; and 2,781 grouse by 1990, which would represent less than 1% of the regional population.

Losses to other species occurring on the proposed mine sites, as mentioned, are not quantifiable at the present level of knowledge. It is estimated that these losses would total less than 1% of the regional populations. However, losses to these other species would occur and would be unavoidable through 1990.

All cultural resources within the ES region would be affected by increased unauthorized collecting, regardless of mitigation measures applied. This destruction would reduce the amount of data available from cultural sites in the region. The significance of this impact is potentially great because the data are the major resources for dating and analyzing cultural activity.

Buried cultural sites within the project areas would be partially or completely destroyed by mining and related surface disturbing activities. Mitigation success would depend on such factors as successfully predicting areas of likely buried sites, the amount of destruction occurring to a site as it is uncovered, and the possibility of it being completely destroyed as a result of not being recognized. The destruction of buried sites could prove to have a significant impact, since many of them, if they exist, are probably very old or well stratified.

Impacts from the proposed actions due to access roads, rail spurs, power lines, pipelines, and other structures would change visual resource management (VRM) Class III areas to Class IV or V. Impacts would remain until structures are removed and areas revegetated.

Strip mined areas would change VRM Class III areas to Class V. This impact would remain until Class III was achieved through extensive natural plant succession on reclaimed areas. Other activities in the region would change the VRM classes if they do not meet management objectives for those classes.

Increased numbers of recreationists would lower the quality of the outdoor recreation experience. Increased use would create conflicts between recreationists and private landowners; which could result in some landowners restricting access across their lands.

The loss of vegetation on the proposed projects would result in an average annual grazing loss of 250 animal unit months (AUMs) thru 1990, which would be less than 0.1% of the grazing in the ES region.

The general increase in dispersed recreational activities would result in impacts on domestic stock that utilize the range. The nuisance problem of leaving gates open would persist although mitigated to a degree. Leaving gates open would unavoidably result in livestock trespassing onto adjoining ranges and likely mixing with other livestock. Livestock molestation would unavoidably increase since the mere presence of more people would cause increased movement of livestock in the area. Rustling of livestock would also increase.

Although the control of haul road dust and fugitive coal dust would be relatively effective, an undetermined amount of dust would settle on adjacent vegetation and result in a reduction of palatability of the range forage.

Mine development would cause destruction of range improvements which would result in altering normal livestock distribution, thereby altering grazing patterns on an allotment. The amount of change cannot be determined until the altered distribution pattern has been monitored.

Mining 204 million tons of coal by 1990 would result in the loss of up to 29.9 million tons due to efficiency levels of present mining methods.

Mine facility and housing construction would require 62,000 cubic yards of aggregate by 1990, which would preclude other uses.

UNAVOIDABLE IMPACTS

Rail spur and road construction would require 289,620 cubic yards of scoria (clinker) by 1990, which would preclude other uses. Mines without reserves of clinker would utilize local sources of gravel, if available, or crushed overburden material.

The proposed actions would cause a shortage of 73 workers in the non-mine related sectors of the economy in 1980, but this would be adjusted by 1985.

Total wage earnings would increase $13.6 million, creating local inflation and reducing the buying power of people on fixed incomes.

This same inflationary trend would force the price of housing higher, creating crowded housing conditions and forcing people to accept housing that is not up to their expectations or desires.

School construction and staffing increases of nineteen teachers (in the two school districts) would be necessary to avoid or moderate crowding and a rise in the student/teacher ratio.

The shortage of health care specialists would become even more acute than at the present time, with one physician, four nurses, and one dentist being due to the proposed actions.

Congestion on local access roads would increase, especially at the time of shift changes. There would be an unquantifiable increase in the number of highway accidents due to the proposed actions.

Traffic delays at railroad crossings along the Union Pacific line, through Nebraska especially, would increase approximately 15 minutes per day due to the proposed actions. Although not quantifiable, the coal trains would increase noise and air pollution along the route.

CHAPTER 6

RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

The region has an established coal industry and is facing other development from oil and gas and expanding uranium exploration, etc. Projected coal development (including the pending three mining and reclamation plans under consideration) in response to national energy needs will increase production to 17.8 from six mines by 1990. Production could level off or continue to increase beyond the 1990 projection, depending on market demands. There are presently approved coal reserves on public and private lands for 31 years at the 1990 production figure and additional reserves in the region for several hundred years of production at the 1990 rate. As reserves at individual mines are depleted, other mines are expected to be developed and absorb the workers. By 1990, a total of 204 million tons of coal would be mined, of which 158 million tons would be from existing mines and 46 million tons from proposed projects. The annual production of 17.8 million tons by 1990 would provide approximately 164 trillion Btus for generation of electricity. A total of 29.9 million tons of coal would be lost by 1990 due to mining method, machinery used, and lack of technology.

The 1977 Carbon County population is estimated to have been 18,137. Total regional population would reach 31,713 by 1990. The proposed actions would increase population by 1,402 persons which is 10.6% of the total increase of 13,229 persons.

In the short term, the increased employment due to the proposed actions would create labor shortages in the non-mine related sectors of the economy. In the long term, as more people move into the region, a labor force of sufficient size to meet the needs of all employers would be available. In addition, this increased employment would tend to hold the unemployment level at its current low level.

Increased wage earnings and higher per capita income would in turn increase retail and wholesale trade over the life of the mine. This would be a short-term gain, while the loss of buying power of people on fixed incomes would be long term.

In the short term, housing prices would rise and crowded conditions would occur. However, over the long term the housing stock would increase allowing such crowded conditions to subside.

Crowding and increased student/teacher ratios would occur in the short term. In the long term, new facilities would be built, more teachers would be hired, and the tax base would increase to pay for these needs.

Health care in this region may never be considered up to standard, but over the long term the population/ health care specialist ratios would return to at least the current levels.

Although there would be a short-term overtaxing of some local services (water, sewer, police and fire protection, solid waste) this situation would be corrected as new sewer and water systems are built, more police and fire personnel are hired, and new solid waste disposal sites are developed in the long term.

It is expected that the community developments, transportation, and related facilities are permanent commitments. The mine areas can be reclaimed and restored to use as mining progresses, but some acreage (Table R4-3) will be committed to mines and ancillary facilities and thus lost to other uses at any one time.

The short-term use of the soil resource would disrupt the productivity levels, destroy existing soil profiles, and increase soil erosional losses on 5,904 acres by 1990. Potential productivity levels would be restored to an estimated 100% of the average premining levels with successful reclamation. The long-term commitment of 344 acres by 1990 for urban needs would utilize the soil resources for an alternate use.

The development of the proposed projects would result in short-term losses of native vegetation on 5,560 acres which would be approximately 0.1% of the ES region. The productivity on the reclaimed lands would be regained within 10 to 15 years after reclamation has been completed. This short term loss would be borne in order to gain the benefits received through the development of the coal on the proposed projects.

The development of 344 acres for housing and support service sites would be a conversion of land use for the long term from lands supporting vegetative cover to land supporting housing and business enterprises. Productivity in relation to vegetation would be lost, but productivity as measured in benefits to other catagories, such as people, would be enhanced for the long term.

A total of 18,305 acres of wildlife habitat would be lost because of the proposed actions and other energy related activities for the short-term period of 1978 to 1990. Activities related to the proposed actions would cause cumulative short-term losses of 1,830 pronghorns and 2,781 sagegrouse by 1990. Unquantifiable losses of small songbirds, rodents, rabbits, hares, reptiles, and amphibians would also occur over the short term, but because of the high reproductive potential of these species, repopulation would be rapid.

SHORT TERM/LONG TERM

The loss of an average of 250 animal unit months (AUMs) of grazing annually, effects of despersed recreational activities on livestock management, and effects of haul road dust and fugitive coal dust would be short-term losses that would be foregone to permit the recovery of coal on the proposed projects.

The 910 acre feet per year (ac ft/yr) of extra water used by municipalities and mines would not be available for other uses during the period of mining, but would become available again after mining ceased. Water use resulting from the Cherokee Mine (750 ac ft/yr) would be committed for about 40 years. The remainder would be available beginning about 1990.

The proposed actions would not affect the future regional air resources. While operating, the proposed actions would consume part of the PSD increments and contribute to any violations of the Wyoming air quality standards near the mines. If the fugitive dust emissions from the mines are excluded from contributing to the PSD increments, a very small portion of the total suspended particulate (TSP) increments would be consumed.

In the long-term, the increased urbanization from population growth associated with the proposed actions would cause a rise in the pollutant concentrations in the towns of the ES region. If the labor force remains after the coal mining has ceased, the projected urban air pollutant concentrations would persist.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The loss of clean, clear air during the operation of the proposed actions would be irreversible. Local emissions of particulates by the mines would irretrievably reduce visibilities around the mines. See the site specific analyses for local impacts of proposed action mines. The mean annual visibilities related to atmospheric particulates would remain unchanged at 47 miles in the region as a whole if the proposed actions were implemented. However, these impacts would not be irreversible.

Increased urbanization of the ES region by implementation of the proposed actions would irretrievably increase ambient pollution concentrations. The urban population growth is expected to cause small increases of ambient TSP concentrations. For all study years, the increases of the populations of Rawlins, Saratoga, and Hanna created by the proposed actions would be less than 7% of the population without the proposed mine. The air quality impact caused by urbanization would be reversible to the extent that the population associated with the proposed actions might move out of the region after the mining ceases.

Losses would include the destruction or disturbance of an undetermined number of uninventoried exposed and unexposed fossil localities.

The destruction of existing soil profiles on 5,904 acres by 1990 from mining, construction of mine facilities, ancillary facilities, and associated urban needs would be an irretrievable loss. This destruction would be 0.1% of the regional area and none of it would occur on alluvial valley floors or prime farm land. The erosional (wind and water) loss of soil caused by mining activities would also be an irretrievable loss.

The three mines would cause no irreversible or irretreviable commitment of regional water resources. The water use caused by the mines (910 ac ft/yr) would last only as long as mining continued. Small irreversible changes could occur in local areas, but these would be minor and would have no lasting effect on the water resources of the region. Disturbed shallow aquifers of small areal extent would not regain their predisturbance characteristics, but these aquifers are not significant to the regional economy. Groundwater levels would return to premining levels after an adequate period of recharge; there would be little to no deterioration of water quality and reclamation would restore the flow of ephemeral streams essentially to premining levels.

The development of housing and support facilities on 344 acres of native rangelands would be a permanent land use change and committment of resources. This loss of habitat is estimated to be less than 0.01% of the total wildlife habitat in the region. Wildlife populations lost on this same area would consist mainly of small songbirds and nongame mammals with very few, if any, big game animals involved.

The destruction of sites would be an irreversible and irretrievable commitment of cultural resources.

There would be a lowering of the quality of the outdoor recreational experiences which currently exist throughout southcentral Wyoming.

Approximately 555.2 million tons of recoverable reserves of coal would be mined. Of this total, 204 million tons would be mined by 1990. This production would result from 46 million tons from the proposed projects and 158 million tons from the existing mines. This coal would be used for steam power generation, and would not be available for future or other uses. No significant amounts of trace elements would be lost due to mining of the coal.

The proposed actions would irreversibly reduce the buying power of people on fixed incomes.

Fatal or debilitating injuries and illnesses would be an irreplaceable loss of the human resource. It is estimated that twenty injuries or illnesses would be due to the proposed mining. What percentage of these would be fatal is not quantifiable.

CHAPTER 8

ALTERNATIVES

This regional ES evaluates the impacts of projected coal development in the southcentral region. The production level evaluated as most probable is dependent in part on federal approval of mining and reclamation plans (M&RPs) on existing federal leases and, in some cases, approval of short-term competitive leases under agreed-upon criteria. However, the Secretary of the Interior is not proposing a particular production level for coal in this ES region. Instead, he is considering actions within his authority that will allow federal coal to be available where needed and under environmentally acceptable conditions to meet market demands and the energy needs of the nation. The approval actions under review at this time are being considered in this context.

In this regional ES, decisions regarding M&RPs and coal-related actions are considered on a regional or subregional basis. Accompanying and future related site-specific statements will evaluate alternatives specific to the individual coal mine proposals. Thus, alternatives for the M&RPs and coal-related actions are evaluated on an aggregate basis in this statement, providing a means of responding to regional or subregional environmental problems or social and economic concerns.

The Secretary's action in regard to the M&RPs under consideration in this ES may be approval as proposed, rejection on various environmental or other grounds, approval in part, or approval subject to such additional requirements or modifications as he may impose under existing laws and regulations. He may also defer decision pending submittal of additional data, completion of required studies, or for other specific reasons. If there are serious environmental concerns as to the coal development, the Secretary may exercise his exchange authority as to the federal coal rights or he may seek congressional action cancelling the federal leases involved.

Review of the federal coal leases and the M&RPs included in this statement indicates that the following administrative alternatives are appropriate for consideration: no action, approval (evaluated as proposed action), and approval subject to specific modifications or requirements. Alternative sites for surface facilities, mining technology and methods, coal transport methods, and rates of production on individual operations are considered where appropriate, but no such modifications have been proposed or identified which would significantly reduce the adverse impacts of coal production from these lands. Any new alternatives surfaced by the review process will be carefully considered.

Development of alternative sources of energy, energy conservation, federal development of the coal, and emphasis on coal development in other regions of the U.S. are more appropriate for consideration on a program rather than a regional basis. These evaluations were made in the previous coal programmatic statement and will be updated and revised as necessary in the new coal programmatic statement now underway.

A "best estimate"as to the probable production level was used as a basis for evaluation of cumulative impacts (Chapter 4) from coal development within the region. Actual production levels attained will depend on demand as well as availability of the coal. Factors influencing production levels in this region included access and economics in relation to other coal sources, transportation, local and state as well as federal approvals, and pollution control requirements and technology. As previously indicated, with approximately 50% of the coal in non-federal ownership, availability of the coal resource to meet market demands or production could well occur at a significantly lower or higher level than the identified probable level. These alternate production scenarios are being evaluated in this chapter to indicate areas of environmental concern or impact sensitivity.

In order that an accurate comparison can be made between the coal-related impacts of the three levels, a baseline description of other regional development that will occur with or without the coal is presented with each coal development level. The baseline description of other development is the same for all three levels of coal development. Only those resource elements which would be significantly impacted are analyzed in this chapter. Table R8-1 presents a comparison of the three levels.

In addition to the analysis of the high and low production levels, this chapter includes a fish and wildlife mitigation alternative and an alternative addressing deferrment of further federal coal development until it has been demonstrated that reclamation can be accomplished in accordance with standards outlined in the Surface Mining Control and Reclamation Act (SMCRA).

NO ACTION OR LOW LEVEL DEVELOPMENT SCENARIO

This section addresses a low level of coal development which involves the continued operation of six existing mines under approved mining and reclamation plans on private, state, and federal coal reserves.

The analysis provides a cumulative regional assessment of impacts expected to occur through 1990 from the con-

Table R8-1

COMPARISON OF IMPACTS

Resource Element	Current	1980 Proposed	1980 Low	1980 High	1985 Proposed	1985 Low	1985 High	1990 Proposed	1990 Low	1990 High
Air Quality										
Addition of particulates to atmosphere (tons/year)*		16,482	13,176	16,482	19,901	14,674	27,965	18,436	13,056	32,004
Maximum short-term TSP concentrations at Rawlins ($\mu g/m^3$)		136	136	145	170	170	190	238	238	310
Topography										
Natural features and drainages altered on (acres)		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Soils										
Acres Disturbed										
Mining and ancillary facility development		2,628	1,837	2,628	9,993	6,080	16,551	15,930	10,370	30,553
Development of other resources (oil, gas, Savery-Pot Hook Project, etc.)		575	575	575	1,460	1,460	1,460	2,375	2,375	2,375
Cumulative acreage Subtotal		3,203	2,412	3,203	11,453	7,540	18,011	18,305	12,745	32,928
Acres Removed from Production										
Due to population demands--										
Coal related		95	0	95	344	0	1,257	344	0	1,434
Other resource related		105	105	105	111	111	111	111	111	111
Cumulative acreage subtotal		200	105	200	455	111	1,368	455	111	1,545

*Low level figure is baseline and includes existing mines, other development, and towns

Table R8-1 (Continued)

COMPARISON OF IMPACTS

Resource Element	Current	1980 Proposed	1980 Low	1980 High	1985 Proposed	1985 Low	1985 High	1990 Proposed	1990 Low	1990 High
Reclaimed acres		2,016	2,010	2,016	8,705	7,085	8,705	13,452	10,450	20,312
Cumulative total coal-disturbed acres		2,723	1,837	2,723	10,337	6,080	17,808	16,274	10,370	31,987
Cumulative total disturbed acres (all resources)		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Water Resources										
Water Use (ac ft/yr)										
Municipal	3,600	4,220	4,190	4,220	5,290	5,040	6,060	5,870	5,610	7,200
Industrial	1,100	1,250	1,170	1,250	1,760	1,200	2,180	1,950	1,300	2,790
Total Regional	223,000	223,770	223,660	223,770	251,360	250,540	252,540	296,120	295,210	298,290
Potential recharge areas disturbed	0	0	0	0	0	0	0	0	0	3
Springs that could be destroyed								4	0	25
Vegetation										
Acres disturbed (cumulative)										
Coal related		2,723	1,837	2,723	10,337	6,080	17,808	16,274	10,370	31,987
Other resource related		680	680	680	1,571	1,571	1,571	2,481	2,486	2,486
Total		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Acres reclaimed (cumulative)		2,016	2,010	2,016	8,705	7,085	8,705	13,452	10,450	20,313
Acres destroyed by fire (average annual estimate)	994	1,140	1,292	1,414	1,292	1,406	1,490	1,254	1,368	1,567

Table R8-1 (Continued)

COMPARISON OF IMPACTS

Resource Element	Current	1980 Proposed	1980 Low	1980 High	1985 Proposed	1985 Low	1985 High	1990 Proposed	1990 Low	1990 High
Fish and Wildlife										
Cumulative acres impacted		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Acres Reclaimed		2,016	2,010	2,016	8,705	7,085	8,705	13,452	10,450	20,312
Acres that will not be reclaimed		200	105	200	455	111	1,368	455	111	1,545
Terrestrial Wildlife										
Habitat acres impacted										
Deer		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Pronghorn Antelope		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Elk							5,754			6,149
Birds (Sage Grouse, Raptors, Song Birds)		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Reptile and Amphibians		3,403	2,517	3,403	11,908	7,651	19,379	18,760	12,856	34,473
Cultural Resources										
Population increase as indication of potential increase of pot-hunting and vandalism to sites (% increase over current population level)		20%	18%	20%	51%	44%	76%	72%	64%	105%

Table R8-1 (Continued)

COMPARISON OF IMPACTS

Resource Element	Current	1980 Proposed	1980 Low	1980 High	1985 Proposed	1985 Low	1985 High	1990 Proposed	1990 Low	1990 High
Recreation										
Recreation use days										
Fishing	76,893	94,354	93,670	94,354	120,582	120,582	114,892	138,903	132,762	165,849
Hunting	28,476	29,083	28,872	29,083	36,202	34,494	42,258	41,227	39,405	49,225
General	98,705	121,218	102,339	121,218	157,340	149,917	183,659	183,903	132,762	165,849
Off-road Vehicle	2,957	3,552	3,526	3,552	4,456	4,245	5,201	5,074	4,849	6,058
Winter sports	9,427	12,433	12,343	12,433	17,823	16,982	20,804	21,565	20,611	25,748
Urban recreation	46,949	60,609	60,169	60,609	82,708	78,806	96,543	99,261	94,874	118,518
Water sports	35,489	44,624	44,300	44,624	59,317	56,518	69,238	70,085	66,987	83,682
Agriculture										
AUMs grazing lost										
Average annual (noncumulative)		805	556	805	805	556	805-1,754	805	556	805-1,754
Total loss (cumulative)		1,610	1,112	1,610	5,635	3,892	NMF	9,660	6,672	NMF
Mineral Resources										
Sand and gravel (cubic yards)		21,000	19,000	21,000	46,000	21,000	91,000	62,000	23,000	122,000
Scoria (cubic yards)		50,480	42,500	50,480	148,900	48,000	270,800	289,620	55,000	447,600
Oil and gas (number of wells)		298	298	298	353	353	353	408	408	408
Coal produced (cumulative millions of tons)		28**	26	28	109	94	144	204	158	317

**Figure for low level is baseline and is included in figures for proposed and high level

NMF = No meaningful figure

Table R8-1 (Continued)

COMPARISON OF IMPACTS

Resource Element	Current	1980 Proposed	1980 Low	1980 High	1985 Proposed	1985 Low	1985 High	1990 Proposed	1990 Low	1990 High
Socioeconomics										
Population										
Coal Induced		161	0	161	1,314	0	5,972	1,402	0	7,554
Total	18,484	22,201	22,106	22,199	27,848	26,459	32,506	31,713	30,107	37,865
Employment										
Coal Induced		72	0	72	597	0	2,606	612	0	3,534
Total	8,067	9,695	9,623	9,695	12,111	11,514	14,120	13,714	13,102	16,636
Personal Income (millions)										
Coal Induced	$	$ 2.6	0	$ 2.6	$ 20.0	$ 0	$ 87.2	$ 22.1	$ 0	$ 129.8
Total	$ 147.1	$ 203.5	$ 200.9	$ 203.5	$ 301.9	$ 281.9	$ 369.1	$ 394.4	372.3	502.1
Retail Sales (millions)										
Coal Induced	$	$ 1.1	$ 0	$ 1.4	$ 8.4	$ 0	$ 36.6	$ 9.2	$ 0	$ 54.5
Total	$ 61.8	85.5	$ 84.4	$ 85.8	$ 126.8	$ 118.4	$ 155.0	$ 165.6	$ 156.4	$ 210.9
Housing Demand										
Coal Induced		108	0	108	545	0	2,172	716	0	2,947
Total	6,697	8,069	7,961	8,069	10,073	9,523	11,700	11,565	10,849	13,796
School Age Population										
District No. 1										
Coal Induced		11	0	11	271	0	1,285	305	0	1,725
Total	3,292	4,120	4,109	4,120	5,521	5,250	6,535	6,554	6,249	7,974
District No. 2										
Coal Induced		20	0	20	28	0	264	42	0	330
Total	1,646	1,824	1,804	1,824	2,007	1,979	2,243	2,145	2,103	2,433

Table R8-1 (Continued)

COMPARISON OF IMPACTS

Resource Element	Current	1980 Proposed	1980 Low	1980 High	1985 Proposed	1985 Low	1985 High	1990 Proposed	1990 Low	1990 High
Socioeconomics Continued										
Physicians										
Coal Induced		0	0	0	1	0	6	1	0	8
Total	9	22	22	22	27	26	32	31	30	37
Dentists										
Coal Induced		0		0	1	0	4	1	0	5
Total	7	14	13	14	17	16	20	19	18	23
Registered Nurses										
Coal Induced		1	0	1	4	0	21	5	0	26
Total	69	76	76	76	95	91	112	108	104	130
Mental Health counselors										
Coal Induced		0	0	0	1	0	1	0	0	2
Total	3	5	5	5	7	6	8	8	7	9
Train Traffic										
Coal Induced		1.1	0	1.1	3.8	0	8.3	3.3	0	12.5
Total	50	59.0	56.6	59.0	67.3	62.3	72.8	73.3	68.2	83.5
Miles of Rail Spur										
Coal Induced		3	3	3	11	3	73	11	3	133
Total		3	3	3	11	3	73	11	3	133
Miles of New Roads										
Coal Induced		4		4	9			9		61
Total		4		4	9	61		9		61
Miles of Utility Lines (Power, Telephone, Pipelines)										
Coal Induced		14	6	14	68	16		77	25	192
Total		64	56	64	211	159	326	318	266	433

tinued operation of the six existing mines plus concurrent development of other resources (oil, gas, uranium, etc.).

Table R8-2 provides detailed information on existing coal development in southcentral Wyoming. Table R8-3 provides surface disturbance, reclamation, and other data for the existing coal mines; Table R8-4 provides similar data for the mines plus other regional non-coal related development. The data are based on the analysis guidelines section in Chapter 1.

Climate

The existing mines are not expected to cause a significant change in the regional climate or meteorology. However, changing the surface contours and the distribution of extracted materials, and the temporary lack of vegetation may cause local changes of the surface meteorology within 1,000 feet of the mine site.

Air Quality

Emissions and Modeling Procedure

The emission sources that are examined for the low level scenario are surface and underground coal mines, uranium mines, towns, and vehicular and rail transportation. The particulate emissions from the coal mines, towns, and the Sweetwater uranium mine and mill are listed in Table R8-5. The locations of the coal and uranium mines for the low level scenario are shown in Map R4-1. The emissions of oxides of sulfur (SO_x) and oxides of nitrogen (NO_x) estimated for Rawlins, Hanna, and Saratoga are shown in Table R8-6. The emissions from the mines and urban areas were calculated using the assumptions and procedures summarized in the Air Quality section of Chapter 4, Regional ES.

The modeling procedures used to predict the annual and short-term total suspended particulate (TSP) concentrations and horizontal visibilities caused by the low level scenario are the same as the ones presented in Chapter 4 (Air Quality) of the regional ES.

Vehicular traffic from continued operation of existing coal and uranium mines would increase the gaseous combustion emissions in the ES region. The impact of these emissions would be intermittent and would generally be confined to narrow corridors parallel to the roadways. The increase of these emissions was not computed for dispersion modeling because it is anticipated that their impact on regional air quality would not be significant.

Emissions were not quantified for oil and gas development in the ES region. No specific information concerning possible operations and locations was available. Employment in the oil and gas industry was projected to remain at or near its 1976 level through 1990 (Chapter 1, Regional Analysis).

The construction of the state prison at Rawlins would begin during the winter of 1977 to 1978 and would be completed in approximately 1½ years. Therefore, particulate and gaseous emissions from construction of the project would cease prior to the first year of analysis of the regional ES.

Emissions from the Bureau of Reclamation's proposed Savery-Pot Hook project were not included in the emission inventory for air dispersion modeling. Like other construction projects, the major pollutant emitted from the project would be fugitive dust. The specific information required to calculate emissions was not available. In addition, the dust which would be released intermittently during the construction of the project is not expected to affect the regional air quality.

The emissions from the proposed wind power generation complex in the Medicine Bow area were not computed. After construction, the complex is not expected to have a discernible impact on the local air quality. Furthermore, the information necessary to compute the fugitive dust emissions during construction was unavailable.

Resultant Air Quality

The area affected by particulate emissions from the existing mines is expected to be limited to within a few miles of the individual mines. Near the Medicine Bow Mine, which is expected to have the most significant impact on regional air quality, the annual ambient TSP concentration is predicted to be 32 micrograms per cubic meter ($\mu g/m^3$) within 3 miles of the mine. This predicted concentration of 32 $\mu g/m^3$ is 1 $\mu g/m^3$ above regional baseline TSP concentrations. At the same distance, the 24-hour ambient TSP concentration from the mine is estimated to be about 110 $\mu g/m^3$. With the inclusion of fugitive dust, the annual and 24-hour Wyoming air quality standards of 60 $\mu g/m^3$ and 150 $\mu g/m^3$ would be exceeded at the boundaries of some of the existing mines. However, with application of the 43 CFR 118 regulations, it is unlikely that the violations discussed above would occur. The annual TSP concentrations predicted for the ES region are shown on Maps R8-1 through R8-3.

The only significant source of gaseous emissions in the ES region would be larger towns. The annual sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) concentrations in Hanna, Saratoga, and Rawlins are expected to remain below the Wyoming annual standards during the study period. Between 1980 and 1990, the annual SO_2 concentration in Rawlins is predicted to increase from 10 $\mu g/m^3$ to 20 $\mu g/m^3$, one-third of the Wyoming standard of 60 $\mu g/m^3$. In Rawlins, the annual NO_2 concentrations are estimated to rise from 40 $\mu g/m^3$ in 1980 to 70 $\mu g/m^3$ in 1990. The 70 $\mu g/m^3$ concentration would be well below the Wyoming standard of 100 $\mu g/m^3$.

Around Hanna and Saratoga, annual average SO_2 and NO_2 concentrations would reach approximately 4 $\mu g/m^3$ and 15 $\mu g/m^3$ respectively, during each of the years of the study period. These concentrations are only 7% and 15%, respectively, of the Wyoming annual air quality standards.

Isopleths of annual average SO_2 and NO_2 concentrations in the ES region for 1980, 1985, and 1990 are shown in the Chapter 8 Regional Technical Report on file at the BLM Rawlins District Office.

Table R8-2

LOW LEVEL OF DEVELOPMENT OF EXISTING
MINES IN SOUTHCENTRAL WYOMING BY 1990

Map Reference	Names	Mining Method[1]	Total[2] Remaining Recoverable Reserves (MM Tons)	Annual Coal Production (MM Tons/Year) 1977	1980	1985	1990
	EXISTING MINES						
CC	Carbon County	U	132.5	0.0	1.5	2.0	2.5
MB	Medicine Bow	S	37.5	2.5	2.5	2.5	2.5
RB	Rosebud	S	36.4	2.0	2.0	2.0	2.0
SI	Seminoe I	S	27.0	2.3	2.3	2.3	0.0
SII	Seminoe II	S	39.5	3.0	3.5	3.5	3.5
VR	Vanguard & Rimrock	S/U	21.0	0.4	1.3	1.3	1.3
	TOTAL	---	293.9	10.2	13.1	13.6	11.8

1 S = Surface, U = Underground

2 Total recoverable reserves from company estimates

Table R8-2
(Continued)

LOW LEVEL OF DEVELOPMENT OF EXISTING
MINES IN SOUTHCENTRAL WYOMING BY 1990

		TIME FRAME			ACRES			
Map Reference	Names	Start Const.	Full Mine Operation	Mine Life (Years Remaining)	Total Project Acres[3]	Federal Lease Acres	Total Surface Acres to be Mined[4]	Average Acres Disturbed Per Year
	EXISTING MINES							
CC	Carbon County	1978	1980	20[6]	10,240	1,920	[5]	[5]
MB	Medicine Bow	1972	1974	10	10,656	1,280	2,500	150
RB	Rosebud	1961	1963	15	13,120	1,193	2,390	175
SI	Seminoe I	1971	1973	8	14,660	6,340	2,035	300
SII	Seminoe II	1972	1974	11	6,323	3,113	1,562	130
VR	Vanguard & Rimrock	1970	1972	22	14,930	8,680	600	100
	TOTAL	--	--	--	69,929	22,526	9,087	855

[3] Includes federal, state, and private

[4] Includes mine pits and on-site haul roads

[5] Underground mine--yearly surface disturbance would be minimal. A total of 200 surface acres would be disturbed during mine life.

[6] Years remaining in presently approved mining and reclamation plans.

Table R8-2
(Continued)

LOW LEVEL OF DEVELOPMENT OF EXISTING MINES IN SOUTHCENTRAL WYOMING BY 1990

Map Reference	Names	EMPLOYMENT 1980 Permanent	EMPLOYMENT 1985 Permanent	EMPLOYMENT 1990 Permanent	Estimated Number Of Unit Trains And Direction of Market[7] 1980	1985	1990	Market Area
	EXISTING MINES							
CC	Carbon County	300	400	500	150E	200E	200E/50W	Georgia & Nevada
MB	Medicine Bow	160	160	160	250E	250E	250E	Midwest
RB	Rosebud	180	180	180	200E	200E	200E	Midwest
SI	Seminoe I	176	176	--	230E	230E	--	Midwest
SII	Seminoe II	145	145	145	350E	350E	350E	Midwest
VR	Vanguard & Rimrock	325	325	325	130E	130E	130E	Midwest
	TOTAL	1,286	1,386	1,310	1,310E	1,360E	1,130E/50W	

[7] Assumes one unit train equals 100 cars, each train having a capacity of 10,000 tons of coal. Does not include return traffic.
W = Westbound E = Eastbound

Table R8-3

PROJECTED CUMULATIVE REGIONAL SURFACE ACRES AT THE LOW LEVEL TO BE DISTURBED AND RECLAIMED AND OTHER DEVELOPMENT DATA ON EXISTING MINES

Activity or Project	Point of Analysis		
	1980	1985	1990
Final Contour[1] (Acres Disturbed)	1,790	6,011	10,286
Mine Facilities[2] (Acres Disturbed)	31	46	61
Ancillary Facilities[3] (Acres Disturbed)	16	23	23
Housing and Support Facilities (Acres Disturbed)	105	111	111
Acres Reclaimed[4]	1,710	5,985	8,550
M&I Water Use (ac ft/yr)	1,700	1,800	1,600
Number of Mines	6	6	6
Tons of Coal Produced	26	94	158
Employment Increase	300	400	324
New Power lines (Miles)[5]	6	16	25
New Rail Spur (Miles)[5]	3	3	3

1 Includes mine pit area, haul roads, topsoil and overburden storage areas.

2 Includes surface facilities, rail spur, access road, power lines, telephone lines, and water storage areas inside project boundary.

3 Includes access roads, haul roads, rail spur, power lines, telephone lines, pipelines, coal conveyor, and water storage outside project boundary.

4 Areas on which topsoil has been replaced and shaped, seedbed prepared, and seeded.

5 Future estimates based on past occurrences.

Table R8-4

PROJECTED CUMULATIVE REGIONAL SURFACE ACRES AT THE LOW LEVEL TO BE DISTURBED AND RECLAIMED AND OTHER DEVELOPMENT DATA ON EXISTING MINES, AND NON-COAL RELATED ACTIVITIES

Activity or Project	Point of Analysis		
	1980	1985	1990
Final Contour[1] (Acres Disturbed)	1,790	6,011	10,286
Mine Facilities[2] (Acres Disturbed)	31	46	61
Ancillary Facilities[3] (Acres Disturbed)	16	23	23
Housing and Support Facilities (Acres Disturbed)	105	111	111
Non-Coal Related Disturbance[4] (Acres)	575	1,460	2,375
Acres Reclaimed[5]	2,010	7,085	10,450
M&I Water Use (ac ft/yr)	223,660	250,540	295,210
Number Coal Mines	6	6	6
Tons of Coal Produced	26	94	158
Number Oil and Gas Wells[6]	298	353	408
Employment Increase	728	1,207	1,131
New Power lines (Miles)[6]	9	34	70
New Rail Spur[6]	3	3	3
New Pipelines (All Kinds)[6]	45	117	182
New Access Roads[6]	0	0	0

1 Includes mine pit area, haul roads, topsoil and overburden storage areas.

2 Includes surface facilities, rail spur, access road, power lines, telephone lines and water storage areas inside project boundary.

3 Includes access roads, haul road, rail spur, power lines, telephone lines, pipelines, coal conveyor and water storage outside project boundary.

4 Includes acres disturbed by oil and gas production, uranium, sand and gravel, prison construction, housing, support facilities, etc.

5 Areas on which topsoil has been replaced and shaped, seedbed prepared, and seeded.

6 Future estimates based on past occurrences.

Table R8-5

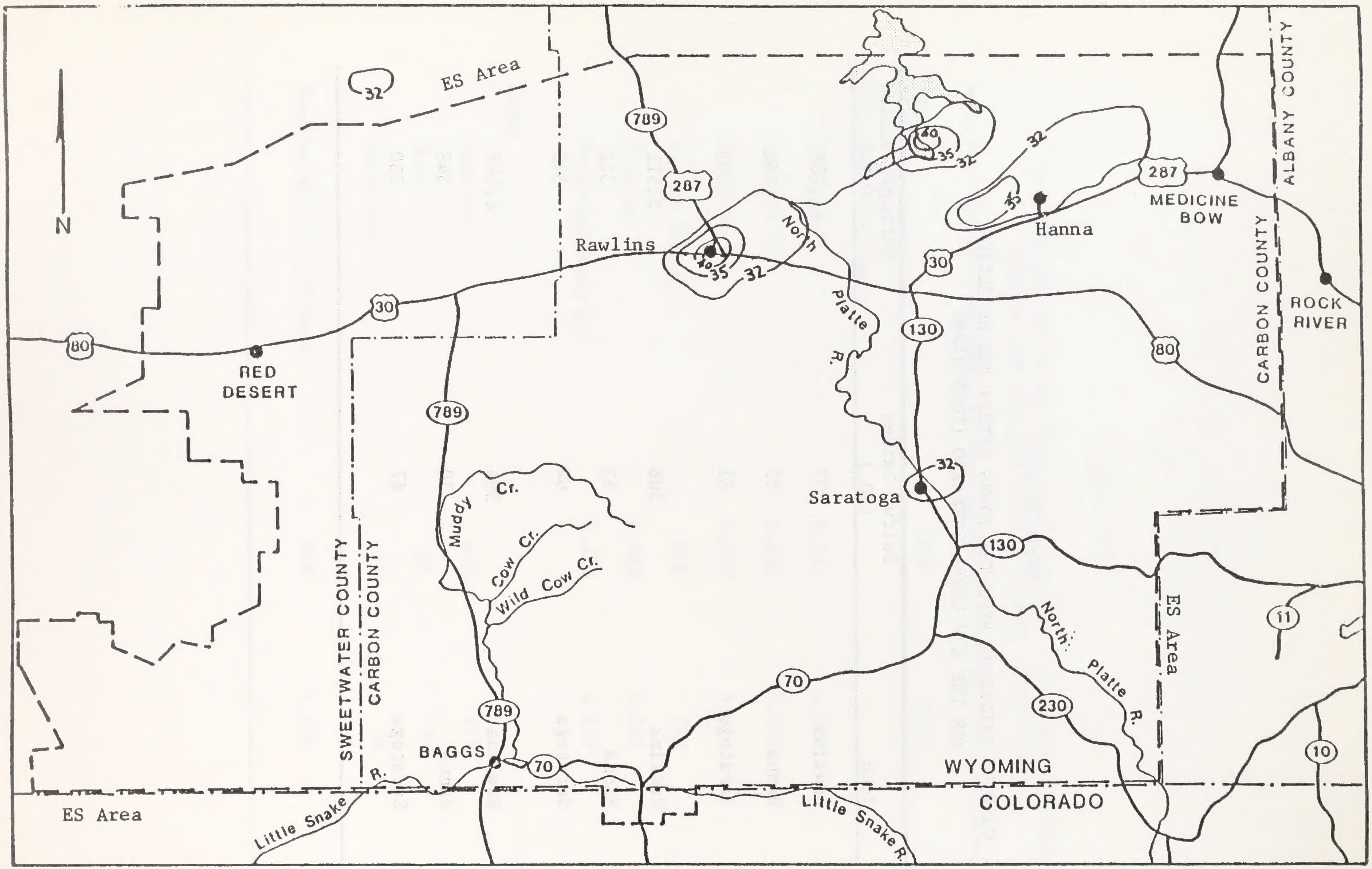
PARTICULATE EMISSIONS FROM MAJOR SOURCES WITHIN SOUTHCENTRAL WYOMING FOR THE LOW LEVEL SCENARIO (TONS/YEAR)

Mine	1980	1985	1990
Existing Coal Mines			
Seminoe I	2,515	1,890	
Seminoe II	2,012	2,012	2,012
Medicine Bow	4,572	4,415	4,415
Carbon County	256	312	367
Rosebud	2,225	2,225	2,225
Vanguard/Rimrock	1,113	1,113	1,113
Towns			
Rawlins	463	623	731
Hanna	65	77	86
Saratoga	75	79	82
Sweetwater Uranium Mine	916	1,756	1,756

Table R8-6

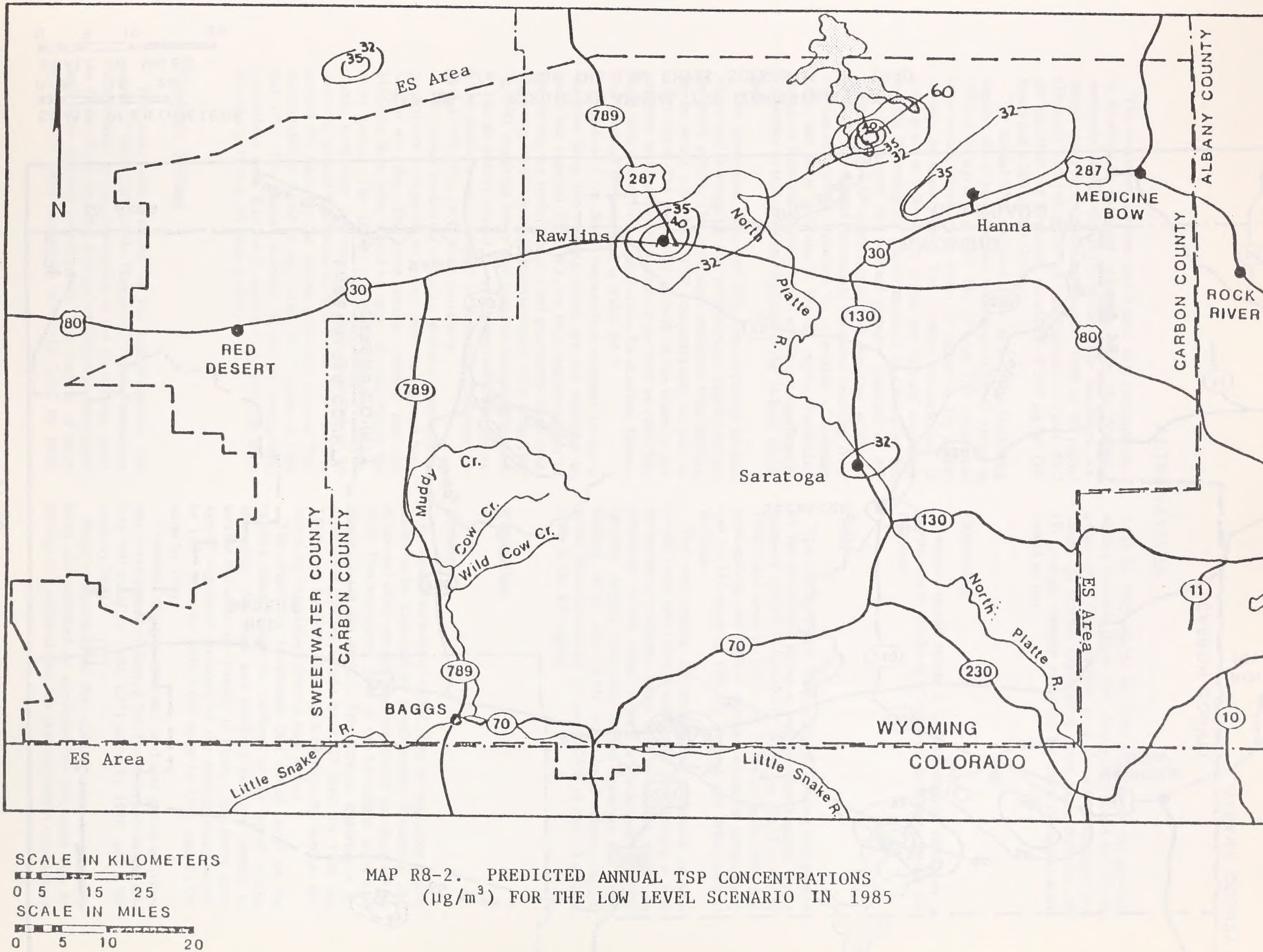
GASEOUS EMISSIONS FROM THE TOWNS WITHIN THE ES REGION
FOR THE LOW LEVEL SCENARIO (TONS/YEAR)

Year	Town	Sulfur Oxides (SO_x)	Nitrogen Oxides (NO_x)
1980	Rawlins	377	1,868
	Hanna	53	261
	Saratoga	61	303
1985	Rawlins	506	2,511
	Hanna	63	312
	Saratoga	64	319
1990	Rawlins	594	2,948
	Hanna	70	348
	Saratoga	67	330

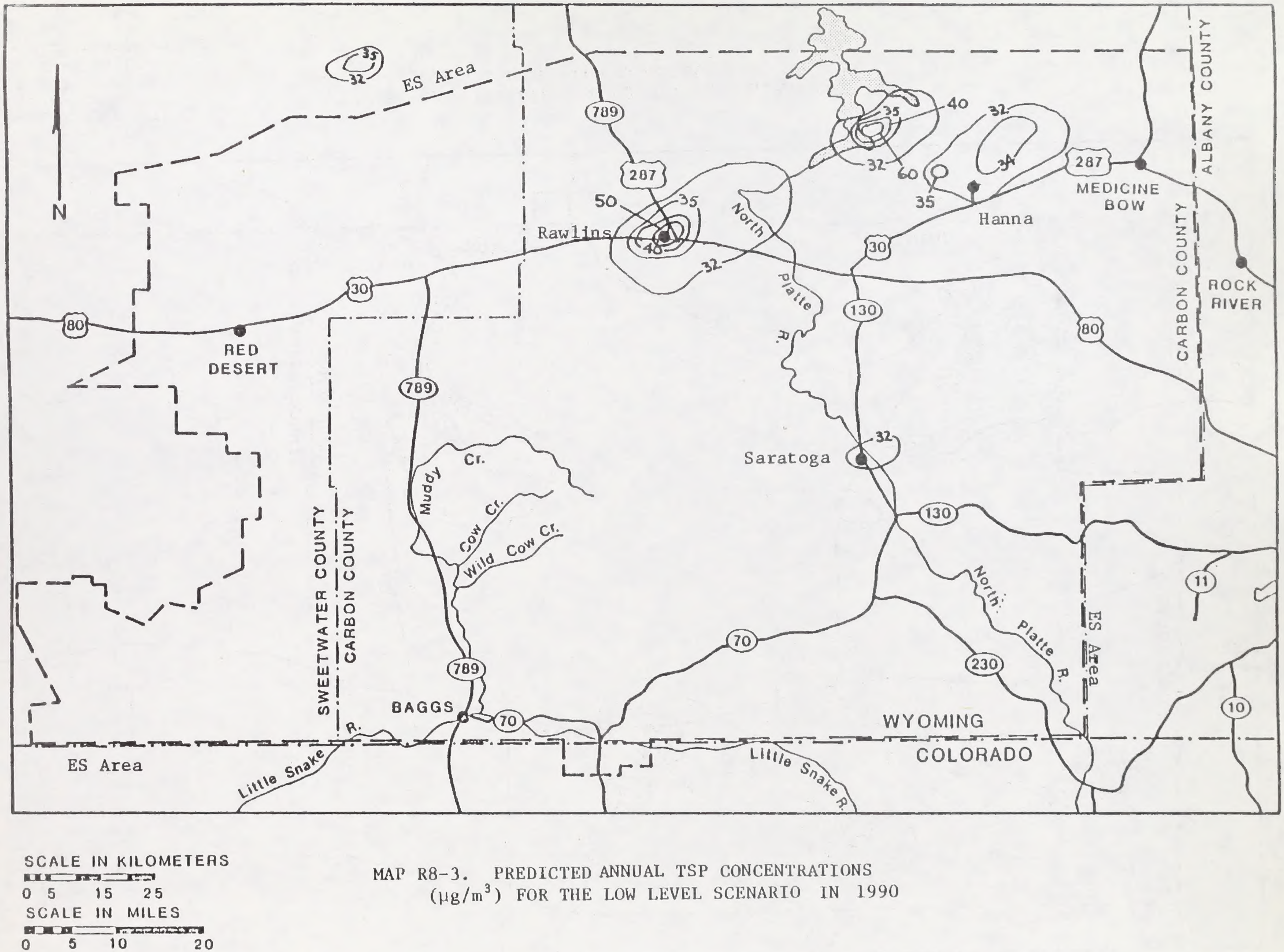


SCALE IN KILOMETERS
0 5 15 25
SCALE IN MILES
0 5 10 20

MAP R8-1. PREDICTED ANNUAL TSP CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO FOR 1980



MAP R8-2. PREDICTED ANNUAL TSP CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO IN 1985



MAP R8-3. PREDICTED ANNUAL TSP CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO IN 1990

The maximum 24-hour and 3-hour SO_2 concentrations in Rawlins are expected to remain below the Wyoming standards during the study period. The maximum predicted short-term concentrations for 1990 of 80 $\mu g/m^3$ (24-hour) and 130 $\mu g/m^3$ (3-hour) shown in Table R8-7 are less than the Wyoming standards of 260 $\mu g/m^3$ (24-hour) and 1,300 $\mu g/m^3$ (3-hour).

The annual TSP concentrations in Rawlins (including fugitive dusts) are expected to increase from 40 $\mu g/m^3$ in 1980 to 60 $\mu g/m^3$ by 1990. The 24-hour TSP concentrations would likewise rise from 136 $\mu g/m^3$ to 238 $\mu g/m^3$ during the same period. The 24-hour concentration of 238 $\mu g/m^3$ in 1990 would exceed the national secondary and the Wyoming air quality standard of 150 $\mu g/m^3$ but would be below the national primary standard of 260 $\mu g/m^3$. The TSP concentrations in Rawlins would be caused by increased particulate emissions resulting from population growth inducted by operation of existing mines and other activities in the ES region. Particulate emissions from the existing mines would not significantly contribute to the potential violation of the 24-hour standards.

The particulate, SO_2, and NO_2 concentrations around Hanna and Saratoga should only increase slightly during the study period. The particulate emissions from existing mines would not cause TSP concentrations to rise in either town. The population growth of the towns is not expected to significantly increase from 1980 to 1990. The short-term concentration predictions for Rawlins, Hanna, and Saratoga are presented in Table R8-7.

Emissions from diesel locomotives required to carry the coal from the existing mines are not expected to cause the regional TSP, SO_2, or NO_2 concentrations to rise during the study period. Coal production from existing mines would decrease approximately 10% from 1980 to 1990, requiring fewer unit trains to transport the coal.

The air quality impact of commuter traffic for the existing mines is not expected to measurably increase regional TSP, NO_2, or CO concentrations.

The annual horizontal visibility related to atmospheric particulates is expected to remain near the regional baseline of 47 miles. The mean annual visibility near the Medicine Bow Mine would be about 30 miles during the study period. The lowest visibilities related to atmospheric particulate concentrations are anticipated to be observed around the Medicine Bow Mine. The visibility around the mine for the highest predicted 24-hour TSP concentrations would be approximately 11 miles in 1985 and 1990. The annual visibility related to atmospheric particulates near Rawlins is estimated to decrease from 40 miles in 1980 to 30 miles in 1990.

Geologic Setting

The main effect would be the transformation into spoils of those parts of the Hanna and Ferris Formations which make up the overburden at the six existing mines in Hanna Basin and the acreage attributed to population and other regional development. The number of acres disturbed in these formations would be 2,517 by 1980; 7,651 by 1985; 12,856 by 1990. Impacts on the geologic setting resulting from this alternative would be: (1) decrease in ground stability over the above acreages and times, (2) seismic exploration made more difficult, and (3) geologic history recorded by these disrupted strata would be lost.

Paleontology

Impacts would occur to paleontological resources in proportion to the level of regional development and disturbance.

Soils

The alteration and destruction of existing soil profiles by the six existing mines as well as other regional developments would cumulatively occur on 2,517 acres by 1980; 7,651 acres by 1985; and 12,856 acres by 1990. Soil productivity and surface acreage would be permanently lost on 111 acres by 1990 for housing and urban support facilities.

The coal mining disturbance and alteration of soils would cause short-term losses in soil productivity as well as increased erosional losses from wind and water. An estimated 10,450 acres would be reclaimed by 1990 (graded, shaped, contoured, topsoil replaced, and initial seeding only). The 12,856 acres (coal related—10,370 acres) disturbed would be about .23% of the 5.5 million acres in the ES region.

Vegetation

Terrestrial

A cumulative total of 12,856 acres of vegetation is projected to be disturbed by development of existing coal mines and other energy resource related development by 1990. This represents .23% of the 5.5 million acres contained in the ES region. The acreage disturbance by other time periods would be 2,517 acres by 1980 and 7,651 acres by 1985. Table R4-6 displays the acreage disturbed by vegetative type and time period.

The vegetative disturbance that would occur on the existing mines would be confined to the actual mining area since the mine and ancillary facilities needed to service the mine are already in place. Cumulative acreage of vegetation disturbed by the existing mines would be 1,837 acres by 1980; 6,080 acres by 1985; and 10,370 acres by 1990.

Combined oil, gas, uranium, sand and gravel activities and development of Savery-Pot Hook project would disturb 680 acres by 1980; 1,571 acres by 1985; and 2,486 acres by 1990.

Since reclamation on the existing mines is presently being accomplished at approximately the same rate as mining, it is assumed that this practice would continue. It

TABLE R8-7

MAXIMUM SHORT-TERM CONCENTRATIONS ($\mu g/m^3$) PREDICTED AROUND TOWNS IN THE ES REGION FOR THE HIGH LEVEL SCENARIO

Town	Pollutant	Averaging Period	1980	1985	1990
Rawlins	TSP	24-hour	145	190	210
	SO_2	24-hour	50	85	100
	SO_2	3-hour	85	140	160
Hanna	TSP	24-hour	130	130	110
	SO_2	24-hour	15	15	15
	SO_2	3-hour	25	25	25
Saratoga	TSP	24-hour	110	110	110
	SO_2	24-hour	15	15	15
	SO_2	3-hour	25	25	25
Medicine Bow	TSP	24-hour	*	110	110
	SO_2	24-hour	*	15	15
	SO_2	3-hour	*	25	25

* Short-term concentrations induced by the high level scenario would not be significant.

is estimated that disturbance on existing mines would occur at a rate of approximately 855 acres per year and reclamation accomplished at a like rate. The amount of unreclaimed disturbed acreage on the existing mines would not exceed an estimated 1,710 acres at any one time. Owing to climatic conditions and soil characteristics of the area, it is assumed that reclaimed areas would not attain adequate vegetative cover of any type until 7½ years after initiating of reclamation efforts. With this premise, it is estimated that the total acreage at any one time that would not have adequate vegetative cover would not exceed 5,558 acres. This acreage would be composed of 1,710 acres of unreclaimed disturbed lands and 3,848 acres of reclaimed (topsoil replaced and seeded) lands in various stages of vegetative establishment, but still unable to sustain any use of the vegetation. Reclamation problems expected would be the same as those outlined in Chapter 4. The reclamation procedures and practices followed in the past by all coal mining operations will have to be modified to meet the requirements of SMCRA.

Other impacts that would be identical to those of the proposed actions, but are unquantifiable would occur with continuation of the existing mines. The only difference would be in the magnitude of the impact as it would relate to the amount of disturbance that is expected to occur. Refer to Chapter 4, Vegetation for identification of these unquantifiable impacts.

Aquatic

All of the existing mining locations are drained by ephemeral streams that flow at limited times such as during spring runoff and after intensive summer rainstorms. Owing to the ephemeral characteristics of the drainages and in view of erosion control measures outlined in the mining plans, the impact on aquatic vegetation from these sites is expected to be minimal.

The Savery-Pot Hook project would affect the aquatic vegetation of the Little Snake River and Savery Creek. The impacts on the aquatic vegetation expected from these developments are impossible to evaluate at this time since no information is available concerning the quantity or quality of aquatic plant life in these streams.

Endangered and/or Threatened

There is no record of any endangered or threatened plant species in the southcentral ES region and it is concluded that the chance of any such plants being present on any of the coal development areas is near zero (Reference, Chapter 2).

Fish and Wildlife

Activities connected with existing coal mines will remove a total of 1,837 acres of wildlife habitat by 1980; 6,080 acres by 1985; and 10,370 acres by 1990. Other energy related activities will remove an additional 680 acres of wildlife habitat by 1980; 1,571 acres by 1985; and 2,486 acres by 1990. Total acres of wildlife habitat lost to all energy related activities in the region will total 2,517 acres by 1980, 7,651 acres by 1985 and 12,856 acres by 1990.

Coal related losses of wildlife habitat would total an estimated 0.03% of the total habitat in the region by 1980, 0.11% by 1985, and 0.18% by 1990. All energy related activities would remove an estimated 0.04% of the total regional wildlife habitat by 1980, 0.14% by 1985, and 0.23% by 1990. An estimate of major wildlife habitat types removed by 1990 by all of these activities would include; sagebrush (9,965 acres), birdfoot sagewort (2,200 acres), greasewood (35 acres), grassland (81 acres), mountain shrub (302 acres), saltbush (155 acres), and riparian (118 acres).

Numbers of wildlife lost or displaced by the removal of various habitat types are not quantifiable since locations of these acreages are not known at the present time. Depending upon the location and type of some of these activities, losses of some wildlife would occur and could be detrimental to the stability of certain populations.

Cultural Resources

Under the low level of coal development, cultural resources could be impacted by the continued development of existing coal mines and other noncoal related development in the region. Since BLM compliance procedures require cultural resource surveys and other mitigating measures, the only cultural sites which might be impacted would be those subsurface sites missed during intensive cultural resource surveys. These potential impacts are not quantifiable.

Recreation Resources

Increased recreational use would occur in all activities because of population increases (see Table R2-20). The increased use would lower the quality of both rural and urban recreation experience in the region.

As a result of increased use, there would be increased maintenance and clean-up costs. There would also be conflicts between local ranchers and the recreationists which would result in the ranchers restricting access across their private lands.

Although the areas which have been identified as having wilderness values are isolated and many are of a badlands nature, people would travel to these areas, especially after they are publicized.

Agriculture

The continuing operation of the existing mines would lead to changes in land use. These changes would ultimately be at the expense of grazing lands since grazing is the dominant use in the area.

The continuation of existing mines would result in the removal of vegetation on approximately 10,370 acres of rangeland by 1990. Acreage of vegetation removed at the end of other benchmark periods would be 1,837 by 1980 and 6,080 by 1985.

The degree of impact on a ranch operation varies greatly due to the location of individual holdings (owned and leased) in relation to the development lands. The magnitude of the impact would also vary with the rate and timing of development of the mine. The magnitude of the impact cannot be quantified since data concerning size of ranch operations impacted are not available.

The disturbed lands are expected to attain full production at the same rate as mining lands are developed, beginning 7½ or more years after reclamation efforts are initiated. The total acreage that would be reseeded, but unable to support grazing at any one time would be 5,558 acres on the existing mines. Grazing loss on this acreage would be approximately 556 animal unit months (AUMs) per year at full coal production level.

Other impacts that would occur under the alternative would be identical to those due to the proposed actions and are unquantifiable. The only difference would be in the magnitude of the impact as it would relate to the size of the area involved. Refer to Chapter 4, Agriculture for identification of these impacts.

Farming

Impacts to farming under this alternative would be the same as those described under the proposed action. Refer to Chapter 4, Farming for the description of these impacts.

Mineral Resources

Cumulative coal production from the existing mines in the region would be 26 million tons by 1980, 94 million tons by 1985, and 158 million tons by 1990, which would be .27% of the Wyoming coal reserves.

Cumulative amounts of sand and gravel needed for housing and mine facilities construction would be 19,000 cubic yards by 1980; 21,000 cubic yards by 1985; and 23,000 cubic yards by 1990. The impact of this loss is not known since regional reserves are not known.

Cumulative amounts of scoria needed would be 42,500 cubic yards by 1980; 48,000 cubic yards by 1985; and 55,000 cubic yards by 1990. Sand, gravel, and scoria operations would disturb approximately 5 acres. The impact of this loss is not known since the regional reserves are not known.

Socioeconomics

The low level of coal development would bring about the same socioeconomic impacts as described in Chapter 2, Future Environment. Increased population, employment, income, etc., would be due strictly to existing coal mines, uranium, oil and gas, and other non-coal related activities. Since the development of the proposed actions would have little impact in the region, not developing them would also have little impact. Although population declines lead to many adverse effects (excessive housing vacancies, excessive private investment, higher taxes, etc.) and it appears that such effects will eventually occur (the available coal will eventually be exhausted), these effects will not occur prior to 1990 and would not be "triggered"by rejection of the mining and reclamation plans.

HIGH LEVEL DEVELOPMENT SCENARIO

This section addresses a high level of coal development which includes the three proposed mines on existing federal coal leases, possible development on areas of interest in the Hanna, Divide, and Savery areas, and continued operation of the six existing mines on private, state, and federal coal reserves.

The possible development mines are in the three areas of interest shown in Map 1 of Appendix A. Two mines (1a and 1b--Map R8-4) would be in the Hanna area of interest. The Savery area of interest would have one possible development mine (3a). The five remaining mines (2a through 2e) would be in the Divide area of interest around Rawlins. The locations of the possible development mines are illustrated in Map R8-4.

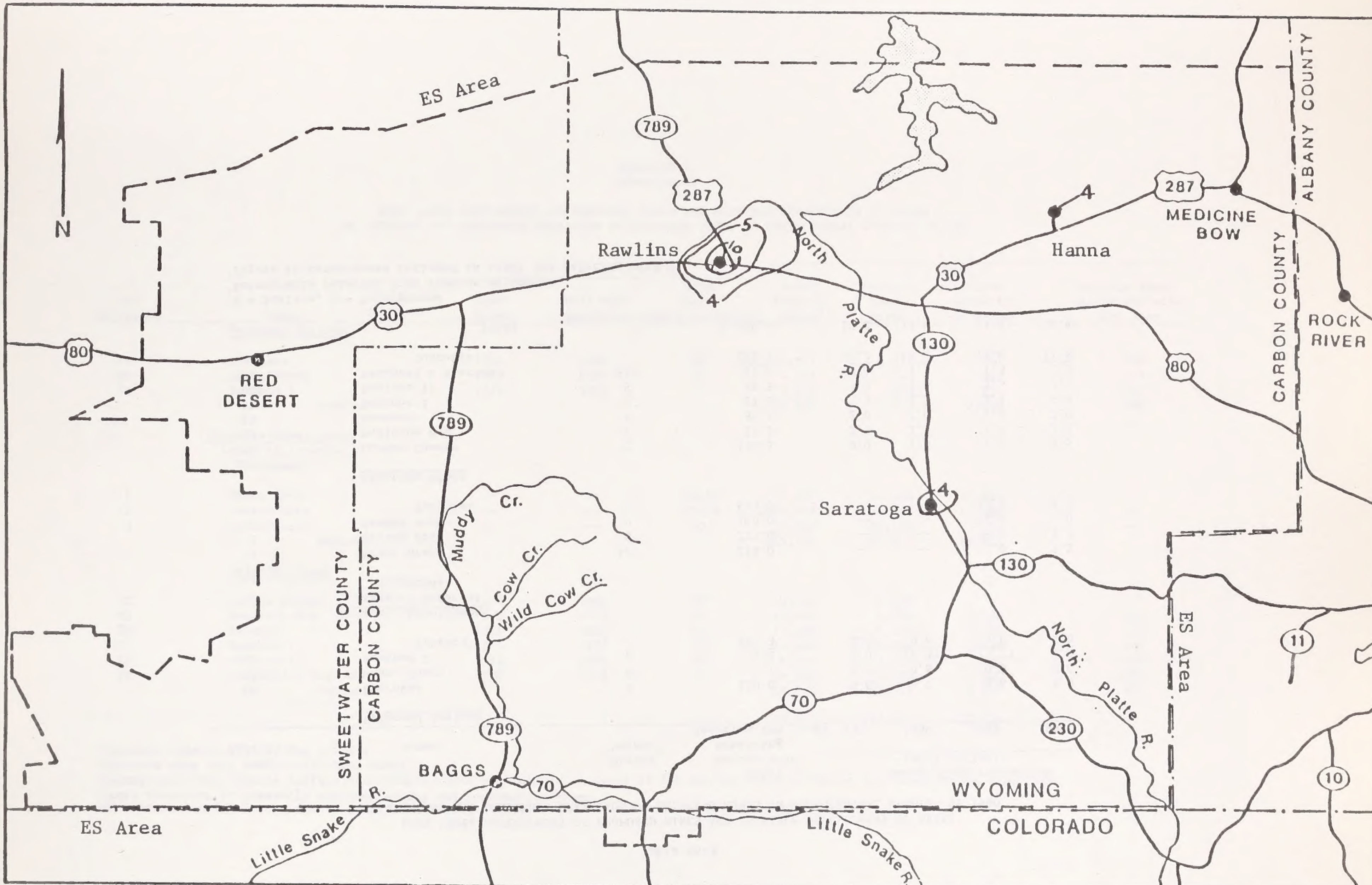
Two levels of analysis are presented; one which analyzes the impacts of the proposed and possible coal developments, and another which analyzes the cumulative regional impacts of the possible coal developments, existing operations, and the concurrent development of other resources (oil and gas, uranium, etc.).

Table R8-8 provides information on the existing, proposed, and possible coal development in southcentral Wyoming through 1990. Table R8-9 provides information on acreage disturbance, reclamation, and other data related to coal development (proposed mines and areas of interest); Table R8-10 provides the same type of information on total coal and other regional non-coal related development. The data are based on the assumptions and analysis guidelines section in Chapter 1.

Climate

The proposed actions and possible development mines are not expected to cause a significant change in the regional climate or meteorology. However, changing the surface contours and the distribution of extracted materials, and the temporary absence of vegetation may cause local changes in the surface meteorology.

Air Quality



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SCALE IN MILES
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MAP R8-4. PREDICTED ANNUAL SO_2 CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO FOR 1980

Table R8-8

HIGH LEVEL DEVELOPMENT OF PROPOSED MINES AND POSSIBLE DEVELOPMENT OF AREAS OF INTEREST AND CONTINUED OPERATION OF EXISTING MINES IN SOUTHCENTRAL WYOMING BY 1990

Map Reference	Names	Mining Method[1]	Total Recoverable Remaining Reserves (mm Tons)[2]	Annual Coal Production (MM Tons/Year) 1977	1980	1985	1990
	Proposed Actions						
CH	Cherokee	S	250.0	0.0	0.0	5.0	6.0
HS	Hanna South	S	6.1	0.0	0.8	0.6	0.0
SI	Seminoe I	S	5.2	0.0	(1.3)[3]	(1.3)[3]	0.0
	Subtotal		261.3	0.0	0.8	5.6	6.0
	Possible Development Areas of Interest (Unleased)						
1	Hanna Area	S/U	258.0	--	--	2.0	5.5
2	Divide Area	S	225.0	--	--	6.3	9.3
3	Savery Area	U	160.0	--	--	4.0	4.0
	Subtotal		643.0			12.3	18.8
	Existing Mines						
CC	Carbon County	U	132.5	0.0	1.5	2.0	2.5
MB	Medicine Bow	S	37.5	2.5	2.5	2.5	2.5
RB	Rosebud	S	36.4	2.0	2.0	2.0	2.0
SI	Seminoe I	S	27.0	2.3	2.3	2.3	0.0
SII	Seminoe II	S	39.5	3.0	3.5	3.5	3.5
VR	Vanguard & Rimrock	S/U	21.0	0.4	1.3	1.3	1.3
	Subtotal		293.9	10.2	13.1	13.6	11.8
	Total		1,198.2	10.2	13.9	31.5	36.6

[1]S = Surface, U = Underground
[2]Recoverable reserves from company estimates
[3]Figure in parentheses included in total for existing mine

Table R8-8
(Continued)

HIGH LEVEL DEVELOPMENT OF PROPOSED MINES AND POSSIBLE DEVELOPMENT OF AREAS OF INTEREST AND CONTINUED OPERATION OF EXISTING MINES IN SOUTHCENTRAL WYOMING BY 1990

		TIME FRAME			ACRES			
Map Reference	Names	Start Const.	Full Mine Operation	Mine Life (Years Remaining)	Total Project Acres[4]	Federal Lease Acres	Total Surface Acres to be Mined[5]	Average Total Acres Disturbed Per Year
	Proposed Actions							
CH	Cherokee	1982	1986	40	10,671	4,271	891	230
HS	Hanna South	1979	1979	10	4,127	640	464	85
SI	Seminoe I	1979	1979	4	3,840	960	734	365
	Subtotal				18,638	5,871	2,089	NMF
	Possible Development Areas of Interest (Unleased)							
1	Hanna Area	--	--	10-50	33,480	14,560	3,803	--
2	Divide Area	--	--	20-30	82,266	34,917	12,050	--
3	Savery Area	--	--	40	50,000	39,400	[6]	--
	Subtotal				165,746	88,877	15,853	
	Existing Mines							
CC	Carbon County	1978	1980	20[7]	10,240	1,920	[6]	[6]
MB	Medicine Bow	1972	1974	10	10,656	1,280	2,500	150
RB	Rosebud	1961	1963	15	13,120	1,193	2,390	175
SI	Seminoe I	1971	1973	8	14,660	6,340	2,035	300
SII	Seminoe II	1972	1974	11	6,323	3,113	1,562	130
VR	Vanguard & Rimrock	1970	1972	22	14,930	8,680	600	100
	Subtotal				69,929	22,526	9,087	855
	Total				254,313	117,274	27,029	

[4]Includes federal, state, and private
[5]Includes mine pits and on-site haul roads
[6]Underground mine--yearly surface disturbance would be minimal. A total of 200 surface acres would be disturbed during mine life.
[7]Years remaining in presently approved mining and reclamation plans.
NMF = No meaningful figure due to changes in mining sequence between operation during the analysis period.

Table R8-8
(Continued)

HIGH LEVEL DEVELOPMENT OF PROPOSED MINES AND POSSIBLE DEVELOPMENT OF AREAS OF INTEREST AND CONTINUED OPERATION OF EXISTING MINES IN SOUTHCENTRAL WYOMING BY 1990

Reference	Names	EMPLOYMENT 1980 Const.	1980 Perm.	1985 Const.	1985 Perm.	1990 Const.	1990 Perm.	Estimated Number And Direction of Market of Unit Trains[8] 1980	1985	1990	Market Area
	Proposed Actions										
CH	Cherokee			200	285		285		500E	600E	Midwest
HS	Hanna South	20	100		100		100	80E	60E	0	Energy Development[9]
SI	Seminoe I		25		25		--	(130E)[10]	(130E)	--	
	Subtotal	20	125	200	410		385	80E	560E	600E	
	Possible Development Areas of Interest (Unleased)										
1	Hanna Area			200	1,200		1,200	--	200E	550E	
2	Divide Area				633		633	--	625E	925E	
3	Savery Area			200	85		800	--	400E	400E	
	Subtotal			400	1,918		2,633		1,225E	1,875E	
	Existing Mines										
CC	Carbon County		300		400		500	150E	200E	50W/200E	Georgia & Nevada
MB	Medicine Bow		160		160		160	250E	250E	250E	Midwest
RB	Rosebud		180		180		180	200E	200E	200E	Midwest
SI	Seminoe I		176		176		--	230E	230E	--	Midwest
SII	Seminoe II		145		145		145	350E	350E	350E	Midwest
VR	Vanguard & Rimrock		325		325		325	130E	130E	130E	Midwest
	Subtotal		1,286		1,386		1,310	1,310E	1,360E	1,130E/50W	
	Total	20	1,411	600	3,714		4,328	1,390E	3,145E	3,605E/50W	

[8]Assumes one unit train equals 100 cars, each train having a capacity of 10,000 tons of coal. Does not include return traffic.
W = Westbound E = Eastbound
[9]It is assumed that Energy Development would ship the coal to Midwest utilities
[10]Included in existing.

Table R8-9

PROJECTED CUMULATIVE REGIONAL SURFACE ACRES AT THE HIGH LEVEL TO BE DISTURBED AND RECLAIMED AND OTHER DEVELOPMENT DATA ON PROPOSED MINES, AND AREAS OF INTEREST

Activity or Project	Point of Analysis		
	1980	1985	1990
Final Contour[1] (Acres Disturbed)	597	6,542	14,869
Mine Facilities[2] (Acres Disturbed)	94	1,263	1,653
Ancillary Facilities[3] (Acres Disturbed)	100	2,640	3,455
Facility Relocation[4] (Acres Disturbed)	--	26	206
Housing and Support Facilities (Acres Disturbed)	95	1,257	1,434
Acres Reclaimed[5]	6	1,620	9,862
M&I Water Use ac ft/yr	110	2,000	3,080
Number Coal Mines	2	9	10
Tons of Coal Produced	2	50	159
Employment Increase	145	2,657	2,807
New Power lines (Miles)[6]	4	110	110
New Rail Spur[6]	--	70	130
New Telephone Line[6]	4	54	54
New Pipeline (all kinds)[6]	--	3	3
New Access Road[6]	4	61	61

[1]Includes mine pit area, haul roads, topsoil and overburden storage areas.

[2]Includes surface facilities, rail spur, access road, power lines, telephone lines and water storage areas inside project boundary.

[3]Includes access roads, haul roads, rail spur, power lines, telephone lines, pipelines, coal conveyor and water storage outside project boundary.

[4]Includes power lines, telephone line and Highway 789 relocation.

[5]Areas on which topsoil has been replaced and shaped, seedbed prepared, and seeded.

[6]Future estimates based on past occurrences.

Table R8-10

PROJECTED CUMULATIVE REGIONAL SURFACE ACRES AT THE HIGH LEVEL TO BE DISTURBED AND RECLAIMED AND OTHER DEVELOPMENT DATA ON PROPOSED MINES, EXISTING MINES, AND AREAS OF INTEREST NON-COAL RELATED ACTIVITIES

Activity or Project	Point of Analysis		
	1980	1985	1990
Final Contour[1] (Acres Disturbed)	2,387	12,553	25,155
Mine Facilities[2] (Acres Disturbed)	125	1,309	1,714
Ancillary Facilities[3] (Acres Disturbed)	116	2,663	3,478
Facility Relocation[4] (Acres Disturbed)	--	26	206
Housing and Support Facilities (Acres Disturbed)	200	1,368	1,545
Non-Coal Related Disturbance[5] (Acres)	575	1,460	2,375
Acres Reclaimed[6]	2,016	8,705	20,312
M&I Water Use ac ft/yr	223,770	252,540	298,290
Number Coal Mines	7	14	15
Tons of Coal Produced	28	144	317
Number Oil and Gas Wells[7]	298	353	408
Employment Increase	873	3,864	3,938
New Power lines (Miles)[7]	13	134	180
New Rail Spur[7]	3	73	133
New Telephone Line[7]	6	62	68
New Pipelines (All Kinds)[7]	45	120	185
New Access Roads[7]	4	61	61

[1]Includes mine pit area, haul roads, topsoil and overburden storage areas.

[2]Includes surface facilities, rail spur, access road, power lines, telephone lines and water storage areas inside project boundary.

[3]Includes access roads, haul road, rail spur, power lines, telephone lines, pipelines, coal conveyor and water storage outside project boundary.

[4]Includes power line, telephone line and Highway 789 relocation.

[5]Includes acres disturbed by oil and gas production, uranium, sand and gravel, prison construction, housing, support facilities, etc.

[6]Areas on which topsoil has been replaced and shaped, seedbed prepared and seeded.

[7]Future estimates based on past occurrences.

Emissions and Modeling Procedures

The TSP emissions from the possible development mines, the proposed actions and the existing mines (coal and uranium mines) are listed in Table R8-11.

Except for access roads, the particulate emissions from the possible development mines were calculated using the procedures and emission factors outlined in the Air Quality section of Chapter 4 of the Regional ES. Access roads for the possible development mines were assumed to be paved which results in an 85% reduction of potential dust emissions from that of an unpaved road. The particulate emissions calculated in Chapter 4 for the proposed actions and the existing mines were used for these sources in the high level scenario. The emissions for all particulate and gaseous pollutant sources modeled for the high level scenario are listed in Tables R8-11 and R8-12. The activities in the region not modeled for the high level scenario include commuter traffic between the towns and mines, oil and gas production, construction of the proposed Savery-Pot Hook irrigation project, and the new Wyoming State Correctional Institute.

Resultant Air Quality

Proposed Actions and Possible Development Mines Alone. The area affected by particulate emissions from the proposed actions and the possible development mines would be limited to a few square miles around the individual mines. The increase of annual total suspended particulate (TSP) concentrations are predicted to be 1 microgram per cubic meter ($\mu g/m^3$) or less beyond 9 miles from the mines. Maps R8-5 and R8-6 show the predicted increases of the annual TSP concentration for these mines in 1985 and 1990. In 1980, the impacts of the proposed actions and possible development mines on TSP, sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) air quality are identical to the impacts of the proposed actions alone. None of the possible development mines would be in operation in 1980. The increases of these pollutants from the proposed actions are addressed in Chapter 4 of the Regional ES.

In 1985, three possible development mines would be producing coal in the Divide area of interest. Two mines (2d and 2e) would be operating within 15 miles from the center of Rawlins. Outside of the mine 2e, the Class II increments and the Wyoming air quality standards may be exceeded in 1985 and 1990. When the coal is mined on both sides of Interstate Highway 80 at mine 2d, the increments and standards may be exceeded along the highway. The particulate emissions from the mine 2d are not predicted to affect the air quality in Rawlins. Increased urbanization of Rawlins associated with the possible development mines would increase annual TSP concentrations by 5 $\mu g/m^3$ within the center of the town. The 24-hour TSP concentration would rise by 25 $\mu g/m^3$ as seen in Table R8-13.

Again, with the application of the 43 CFR 118 regulations, the violations of the Class II increment will not occur.

The only significant source of gaseous emissions in the ES region would be the large towns. Increases in population induced by the proposed actions and the possible development mines would cause increased SO_2 and NO_2 emissions from the towns. These increased emissions would, in turn, impact the regional air quality.

The growth of Rawlins associated with the proposed actions and the possible development mines would raise the annual SO_2 and NO_2 concentrations within the center of Rawlins by 4 and 10 $\mu g/m^3$ in 1985, and 5 and 25 $\mu g/m^3$ in 1990. The maximum predicted annual increase of 5 $\mu g/m^3$ for SO_2 is 25% of the allowable Class II Prevention of Significant Deterioration (PSD) increment of 20 $\mu g/m^3$. There is no established PSD increment for NO_2.

Population increases at Hanna and Saratoga induced by the proposed actions and the possible development mines would not cause a quantifiable increase in regional SO_2 or NO_2 levels.

Isopleths of annual average SO_2 and NO_2 increases in the ES region induced by the high level scenario for 1985 and 1990 are shown in the Chapter 8 regional technical report on file at the BLM Rawlins District Office.

In 1990 the active mining areas of the possible development mines 2d, 2c, and 2e would be within 8 miles of the intersection of Interstate Highway 80 and U.S. 30 on the west side of Rawlins. As shown on Map R8-6, the predominant westerly winds of the ES region cause the highest TSP concentrations east of the mines. The mines are predicted to increase the annual TSP concentrations along Interstate 80 by 1 $\mu g/m^3$ in 1990. The highest 24-hour TSP concentrations along the interstate from the mines is predicted to be about 37 $\mu g/m^3$. Because the active mine areas of mines 2c and 2e would be near the center of their project areas, the increase of annual TSP concentration at the intersection of Interstate 80 and U.S. 30 from the mines is expected to be less than 1 $\mu g/m^3$. The Wyoming air quality standards and the PSD increments would be exceeded within the mine project areas. The possible development mines 2c and 2e may cause the 24-hour Class II increment to be exceeded along Interstate 80 during 1990 when coal closest to the highway is mined.

The population growth in Rawlins from the possible development mines is predicted to cause the annual TSP concentrations to increase in 1990 by 5 $\mu g/m^3$ (see Map R8-6). In 1990, the short-term TSP and SO_2 concentrations from increased urbanization of Rawlins would range from 20 $\mu g/m^3$ to 30 $\mu g/m^3$. The short-term TSP and SO_2 concentrations in Rawlins would not significantly change from 1985 levels as seen in Table R8-7.

In the Hanna area of interest, mine 1a would not interact with the two proposed actions, Hanna South and Seminoe I Amendment Mines, or with Hanna, Wyoming. In Hanna, the Hanna South Mine would cause a significant increase of the TSP concentrations in 1980 and 1985. The population growth from the proposed actions and possible development mines is not expected to cause a noticeable increase of TSP, SO_2, and NO_2 concentrations in Hanna or Saratoga, the other large towns in the area of interest. Within possible development mine 1a

Table R8-11

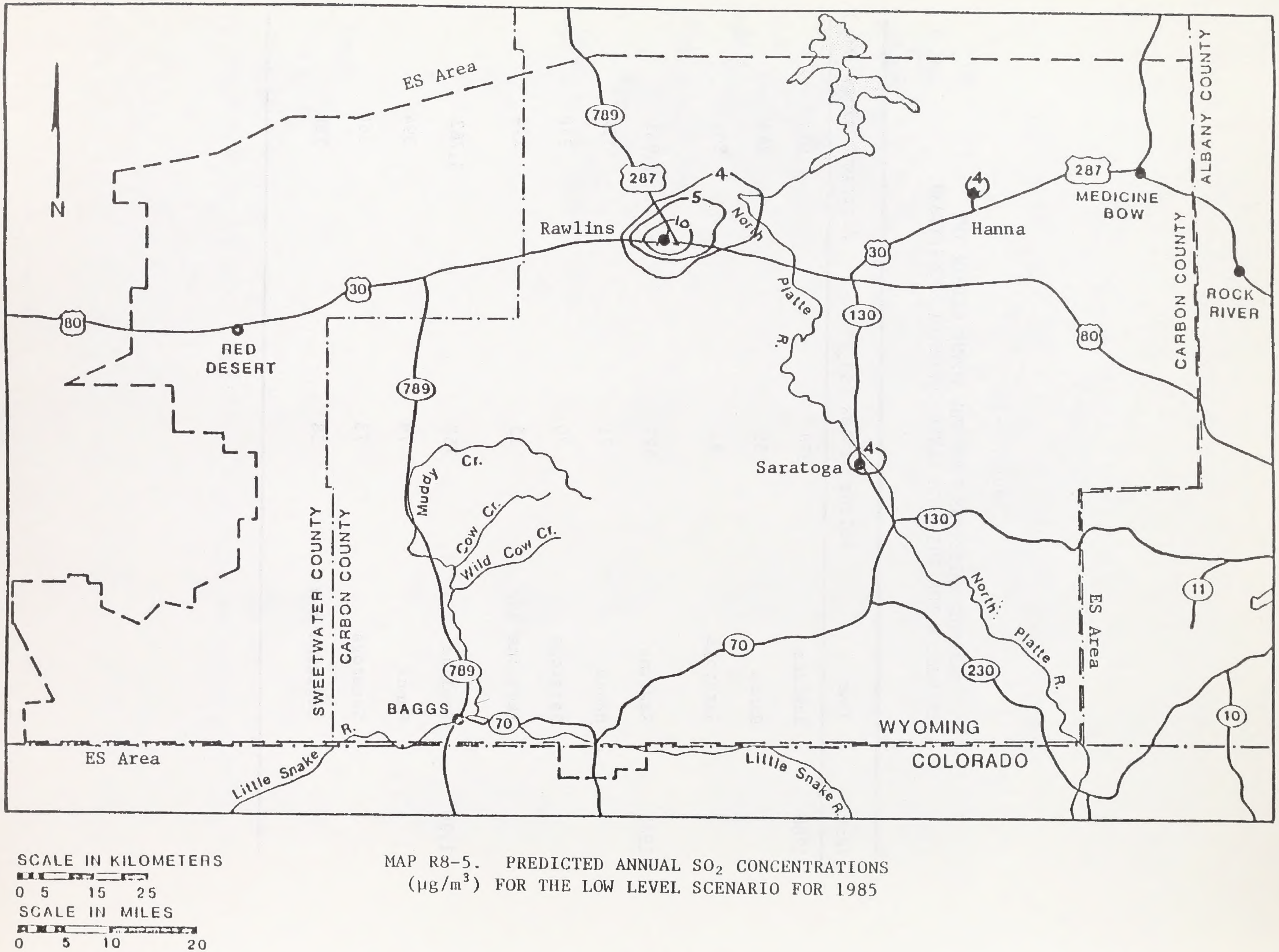
PARTICULATE EMISSIONS IN THE SOUTHCENTRAL WYOMING ES REGION FOR THE HIGH LEVEL SCENARIO (TONS/YEAR)

Source	1980	1985	1990
Existing Coal Mines			
Seminoe I	1,474	1,890	-
Seminoe II	2,012	2,012	2,012
Medicine Bow	4,572	4,415	4,415
Carbon County			
Rosebud	2,225	2,225	2,225
Vanguard/Rimrock	1,113	1,113	1,113
Sweetwater Uranium Mine	916	1,756	1,756
Proposed Actions			
Seminoe I Amendment	1,931	-	-
Hanna South	1,375	1,246	-
Cherokee	-	3,981	5,380
Possible Development Mines			
1a		821	2,738
1b		533	533
2a		3,728	4,260
2b			2,130
2c			533
2d		852	852
2e		2,130	2,130
3a			392
Towns			
Rawlins	465	734	933
Hanna	67	88	98
Saratoga	76	86	90
Medicine Bow		43	47

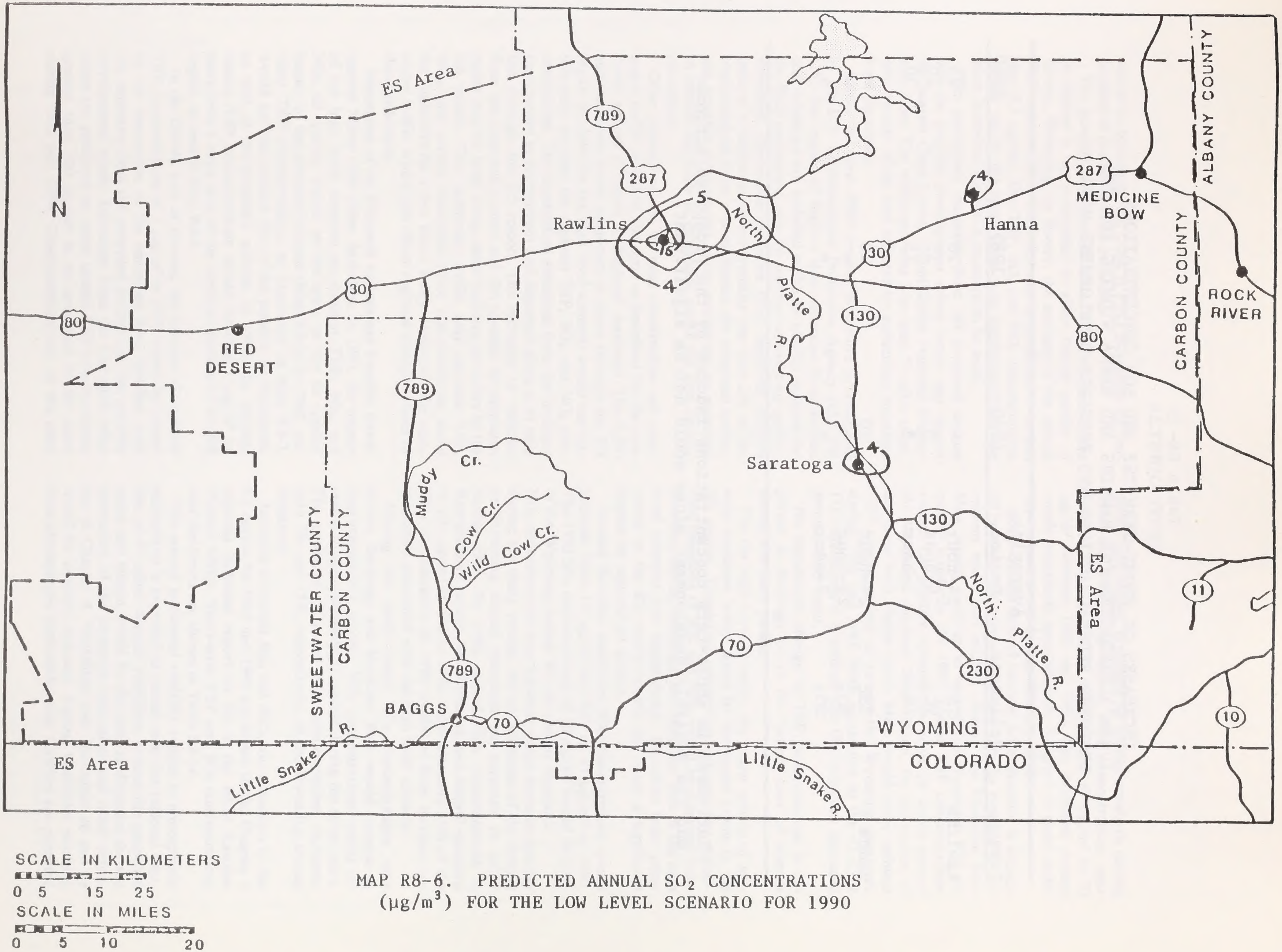
Table R8-12

GASEOUS EMISSIONS FROM THE TOWNS WITHIN THE ES REGION FOR THE HIGH LEVEL SCENARIO (TONS/YEAR)

Year	Town	Sulfur Oxides (SO_x)	Nitrogen Oxides (NO_x)
1980	Rawlins	378	1,878
	Hanna	55	268
	Saratoga	62	306
1985	Rawlins	597	2,961
	Hanna	71	354
	Saratoga	70	348
	Medicine Bow	35	174
1990	Rawlins	758	3,763
	Hanna	79	394
	Saratoga	73	364
	Medicine Bow	38	188



MAP R8-5. PREDICTED ANNUAL SO_2 CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO FOR 1985



MAP R8-6. PREDICTED ANNUAL SO_2 CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO FOR 1990

Table R8-13

INCREASES OF SHORT-TERM TSP AND SO_2 CONCENTRATIONS ($\mu g/m^3$) PREDICTED FOR RAWLINS AND HANNA WYOMING FOR THE PROPOSED FEDERAL ACTIONS AND POSSIBLE DEVELOPMENT MINES

Town	Pollutant	Averaging Period	1980	1985	1990
Rawlins	TSP	24-hour	*	20	25
	SO_2	24-hour	*	15	20
	SO_2	3-hour	*	25	30
Hanna	TSP	24-hour	20	20	*
	SO_2	24-hour	*	*	*
	SO_2	3-hour	*	*	*

* Increases in short-term concentrations induced by the propposed actions and the possible development mines would not be significant.

and at its boundary, the Class II PSD increment for particulates is predicted to be exceeded.

The possible development mine 3a in the Savery area of interest is not anticipated to affect the air quality of Savery, Wyoming. In Savery, the increase of the annual TSP concentrations from the mine is predicted to be less than 0.5 $\mu g/m^3$. The TSP, SO_2 and NO_2 concentrations would rise in the town from new employees from the mine; however, the rise is expected to be small.

The particulate emissions from the proposed actions and the possible development mines would not impact the nearest Class I area, Mount Zirkel National Wilderness Area. The wilderness area is at least 70 miles away, well outside of the area affected by particulate emissions from the mines.

Under the new PSD review procedure promulgated by the U.S. Environmental Protection Agency (43 CFR 118), the impact of fugitive dust emissions from surface coal mines are not included in the air quality analyses for the PSD increments, nor for national ambient air quality standards. Particulate emissions from industrial process units of a surface mine are typically less than 2% of the total emissions from a mine. Hence, the proposed actions and possible development mines would not be expected to exceed the Class II increment under the new review procedure.

Other impacts caused by mine construction and commuter traffic would be the same as described for the proposed actions (Chapter 4, Regional Analysis). The 2,500 additional unit trains projected to move through the ES region by 1990 for the high level scenario would not significantly increase the regional TSP, SO_2, and NO_2 concentrations. The combustion emissions from the locomotives would be intermittent and dispersed along a 45 mile line through the ES region. The increases of vehicles from the proposed actions and the possible development mines may be large along some highway corridors in the ES region. The commuter traffic may increase TSP, NO_2, and carbon monoxide (CO) concentrations along the highways for a few hours a day. However, the commuter traffic would not affect regional concentrations of these pollutants.

Interaction of the Proposed Actions and Possible Development Mines with Other Activities. In 1980, the impact of the high level scenario on ambient TSP, SO_2, and NO_2 air quality would be the same as the air quality impact of the proposed actions (Map R4-5). In 1985, ambient TSP concentrations, as illustrated in Map R8-7, would increase around five of the possible developments as well as the proposed actions. In 1990, the ambient annual TSP concentrations would increase 1 $\mu g/m^3$ or more over a large area of the northern portion of the ES region, as seen in Map R8-8.

In the Divide area of interest, the increase of regional TSP concentrations of 1 $\mu g/m^3$ in 1990 would be caused by the interaction of the emissions from Rawlins with the emissions from the proposed actions and the possible development mines. Emissions from the Cherokee Mine alone are predicted to cause annual TSP concentrations greater than 100 $\mu g/m^3$ in an area east of the mine during 1985 and 1990. Concentrations east of the mine would also exceed Wyoming air quality standards during 1985 and 1990. The annual TSP concentrations near Rawlins are expected to increase from 40 $\mu g/m^3$ to 70 $\mu g/m^3$ between 1980 and 1990. The proposed actions would contribute approximately 5 $\mu g/m^3$ to these ambient concentrations during 1985 and 1990.

In the Hanna area of interest, no interaction is expected between the proposed actions and the possible development mines and existing mines. The Medicine Bow Mine would continue to exceed the Wyoming TSP air quality standards. By 1990, annual TSP concentrations around the possible development mine 2b would exceed the Wyoming standard. Near Hanna, the interaction of the town with Hanna South Mine would cause ambient TSP concentrations to exceed the Wyoming standards during 1980 and 1985. With application of the 43 CFR 118 regulations, it is unlikely that the violations discussed above would occur.

No significiant change in TSP concentrations is expected in Saratoga or in the Savery area of interest during the study period.

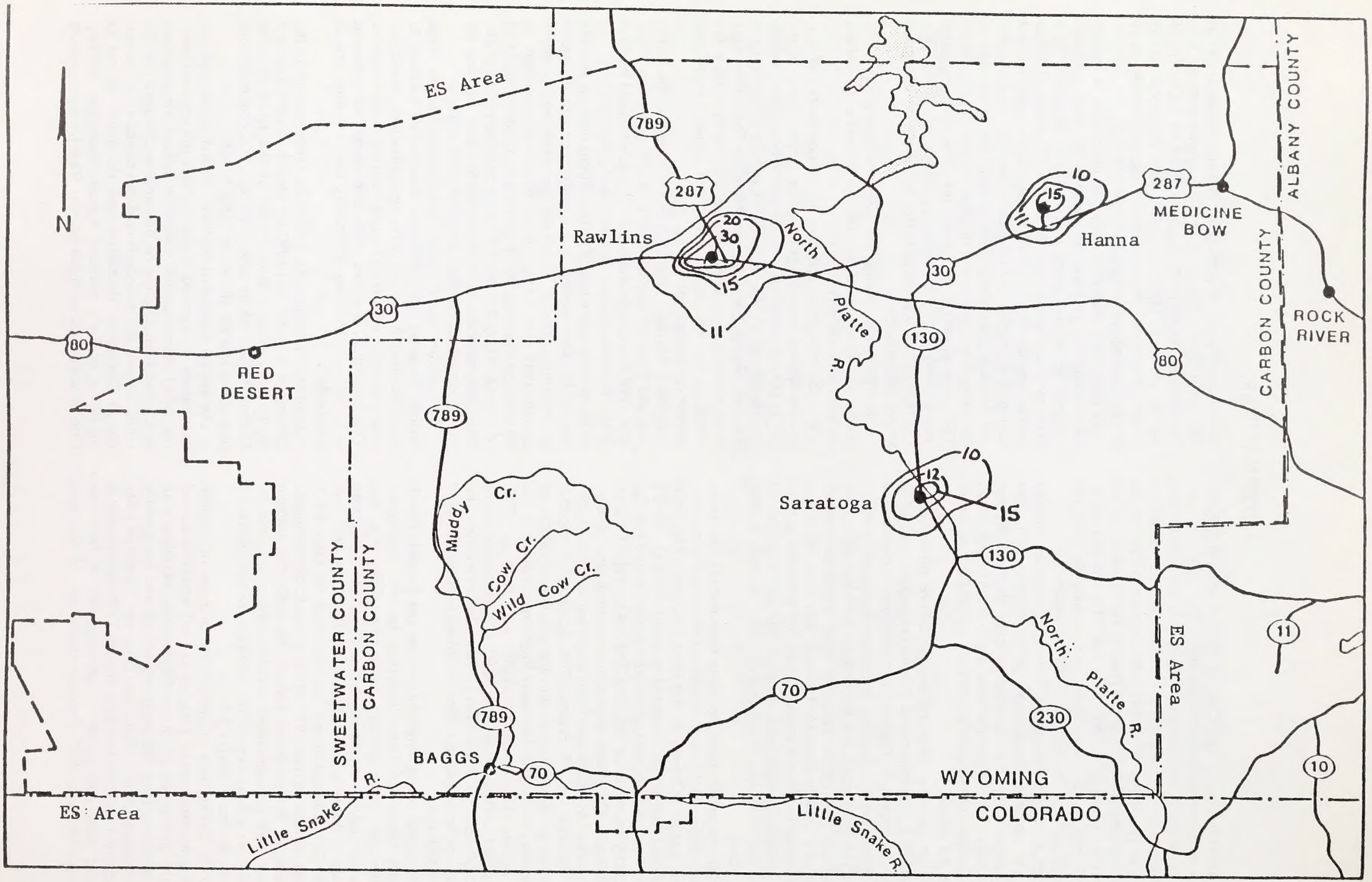
For the high level scenario, the major source of gaseous emissions would again be the larger towns in the ES region. Population predictions indicate that significant emissions of SO_2 and NO_2 would be expected from Rawlins, Hanna, Saratoga, and Medicine Bow if the high level scenario was implemented. Emissions from other towns in the ES region would not cause a significant impact on regional air quality.

Around Rawlins, maximum SO_2 concentrations would increase from 15 $\mu g/m^3$ in 1985 to 30 $\mu g/m^3$ in 1990. The 1990 SO_2 concentrations of 30 $\mu g/m^3$ would be 50% of the Wyoming annual SO_2 air quality standard. NO_2 concentrations near Rawlins would increase steadily during the study period, but no violations of the federal or Wyoming annual standards are expected to occur during 1985. By 1990, annual NO_2 concentrations in Rawlins may exceed the Wyoming and federal standard of 100 $\mu g/m^3$ by 5% to 10%. Approximately 25% of the NO_2 concentration in 1990 would be from increase urbanization associated with the high level scenario.

During the study years, SO_2 concentrations near Hanna, Saratoga, and Medicine Bow would increase to approximately 4 $\mu g/m^3$. NO_2 concentrations would increase to approximately 15 $\mu g/m^3$ during the same years. The predicted SO_2 and NO_2 concentrations represent only 7% and 15%, respectively, of the Wyoming annual standards.

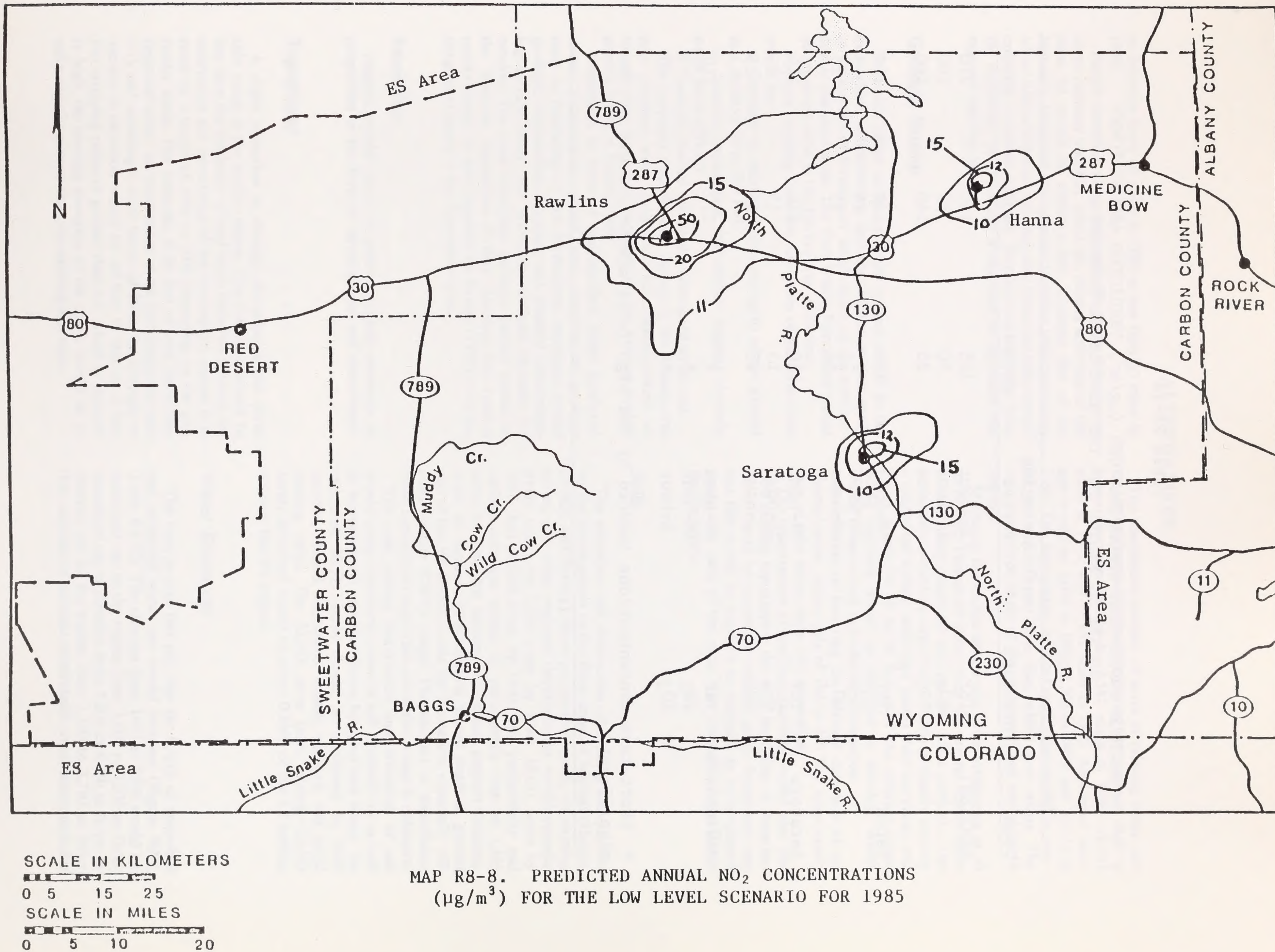
Isopleths of annual SO_2 and NO_2 concentrations in the ES region for 1985 and 1990 are shown in the Chapter 8 regional technical report on file at the BLM Rawlins District Office. Short-term TSP and SO_2 concentrations near the towns are shown in Table R8-14.

The annual horizontal visibility related to atmospheric particulates is expected to remain near the regional baseline of 47 miles. Annual visibilities around the proposed mines and Hanna would be the same as discussed for the interaction of the proposed coal mines and other activities in Chapter 4. Visibilities near the mines 2b and 1a would be similarly reduced. Annual visibilities resulting from atmospheric particulates near Rawlins are expected



SCALE IN KILOMETERS
0 5 15 25
SCALE IN MILES
0 5 10 20

MAP R8-7. PREDICTED ANNUAL NO_2 CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO FOR 1980



MAP R8-8. PREDICTED ANNUAL NO_2 CONCENTRATIONS ($\mu g/m^3$) FOR THE LOW LEVEL SCENARIO FOR 1985

Table R8-14

MAXIMUM SHORT-TERM CONCENTRATIONS ($\mu g/m^3$) PREDICTED AROUND TOWNS IN THE ES REGION FOR THE HIGH LEVEL SCENARIO

Town	Pollutant	Averaging Period	1980	1985	1990
Rawlins	TSP	24-hour	145	190	210
	SO_2	24-hour	50	85	100
	SO_2	3-hour	85	140	160
Hanna	TSP	24-hour	130	130	110
	SO_2	24-hour	15	15	15
	SO_2	3-hour	25	25	25
Saratoga	TSP	24-hour	110	110	110
	SO_2	24-hour	15	15	15
	SO_2	3-hour	25	25	25
Medicine Bow	TSP	24-hour	*	110	110
	SO_2	24-hour	*	15	15
	SO_2	3-hour	*	25	25

* Short-term concentrations induced by the high level scenario would not be significant.

to decrease from 40 miles in 1980 to less than 30 miles in 1990.

People traveling along Interstate Highway 80 may observe reduced visibility when the mining activities of the mine 2d would be within a few thousand feet of the highway. However, the greatest visibility reductions may occur where the truck hauling coal from the mine would cross the interstate highway. Beyond one-half mile from the crossover, the visibility is expected to approach the regional baseline levels.

Geologic Setting

The main effect on the geologic setting would be the excavation, redistribution, and transformation into spoils of those parts of formations which make up the overburden at the mine sites. The Fort Union Formation would be impacted most in the Divide area of interest.

Impacts resulting from the disruption of the formations would be:

1. Decrease in stability (shear strength) of the ground to a depth of 50 to 500 feet.
2. Seismic exploration for deeper mineral deposits made more difficult.
3. Geologic history recorded in disrupted strata lost.

The proposed underground mining in the Hanna area may produce some rockbursts (microearthquakes) although they have not occurred in the existing underground mines in Hanna Basin.

Subsidence in areas of underground mines (analyzed under Topography) would have impacts on geology such as fracturing of the formations, changing spatial geologic relationships, trapping and possibly contaminating surface water, and providing artificial channels for erosion. The most important geologic hazard would be the fractures themselves if they develop into tension cracks similar to that reported by Rooks (1977) over underground mines in the Kemmerer area.

Paleontology

Impacts would occur to paleontological resources in proportion to the level of development and disturbance.

Topography

A slight reduction in average elevation would probably occur at the surface mines. The reduction would be less than the thickness of coal seam removed because the excavation and reworking of the overburden causes it to swell by a factor of 10% to 30% depending on the particular strata. For example, if 20 feet of coal have been removed under an overburden of 60 feet (stripping ratio 3:1), and assuming a swell factor of 20%, the average reduction in elevation would be -20 feet 12 feet or -8 feet. For stripping ratios of greater than 5:1, which is unusually high, the average elevation of the spoils would be locally slightly greater than the existing elevation.

The cumulative number of acres of existing strata that would be converted to spoils having the average slightly lower elevation would be 2,387 acres in 1980; 12,553 acres in 1985; and 25,155 acres in 1990. Reclaimed acreage would be 2,016 in 1980; 8,705 in 1985; and 20,312 in 1990. The topography in these spoil areas would be similar to, but different than that which now exists. The maximum slope angle of the reclaimed land would be 16 degrees.

Mining in the Hanna area could cause subsidence of 10 to 20 feet. This could occur over the several square miles of area being mined by collapse and pillar methods. The subsidence would be expected to settle gradually leaving a readjusted surface with high points over the pillars and lower points by 10 to 20 feet over the collapse areas. Some fractures would be expected to develop, which would be smoothed over during reclamation.

In addition to lowering the average elevation of reclaimed areas, active cuts of 100 to 150 feet deep would exist at strip mines under this alternative.

The construction of ancillary facilities would also disturb existing topography; the most important of these impacts would be caused by railroad spurs. Numerous cuts and fills would be required to maintain an even railroad grade into each of the mine sites from the main Union Pacific tracks.

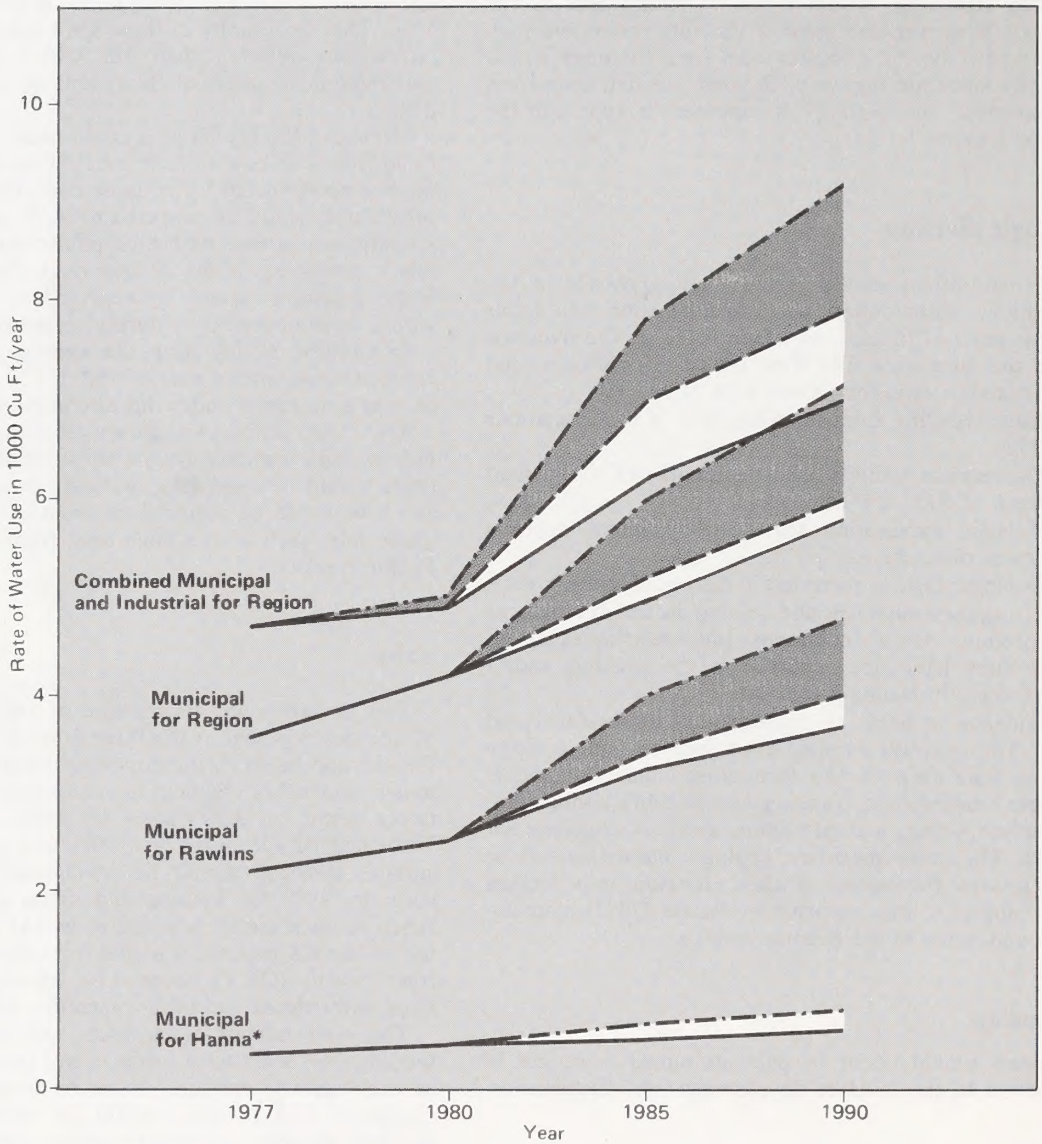
Soils

The alteration and destruction of existing soil profiles by the development in the three areas of interest (Hanna, Divide, and Savery), three proposed projects, six existing mines, and other regional developments would cumulatively occur on 3,203 acres by 1980; 18,011 acres by 1985; and 32,928 acres by 1990. Soil productivity and surface acreages would be permanently lost on 1,545 acres by 1990 for housing and urban support facilities. Also, an increase in population would result in greater use of the ES region's soils for recreation, especially off-road vehicle (ORV) usage. The amount of disturbance from unrestricted and other recreation usage is unknown.

The coal mining disturbance and alteration of soil would cause short-term losses in soil productivity as well as increased soil erosional losses by wind and water. An estimated 20,312 acres would be reclaimed by 1990 (graded, shaped, contoured, topsoil replaced, and initial seeding only). The 32,928 acres (coal related—30,553 acres) disturbed would be about 0.59% of the 5.5 million acres in the ES region.

Water Resources

The rate, in acre feet per year (ac ft/yr), of municipal and industrial water use would increase (Figure R8-1; Table R8-15). The changes from 1977 to 1990 would be: municipal use in the region from 3,600 to 7,200 ac ft/yr; municipal use in Rawlins from 2,200 to 4,780 ac ft/yr; industrial use in the region from 1,100 to 2,790 ac ft/yr. The amount of increase attributable to all mines included



*Same Line Applies for Saratoga

——— Rate of Water Use Without Any New Mines

– – – – Rate of Water Use With Proposed Mines Discussed in Chapter 4

–·–·– Rate of Water Use With High Level Production

Impact From Proposed Mines

Impact From High-Level Production

Figure R8-1

PREDICTED WATER USE WITH HIGH-LEVEL PRODUCTION ALTERNATIVE

Table R8-15

PROJECTED USE OF WATER WITH THE HIGH LEVEL SCENARIO
(In ac ft/yr)

Time and Degree Of Regional Development	Uses Impacted By Coal Mining		Uses Not Impacted By Mining			Total Use
	Municipal Supply In The Region	Industrial	Irrigation & Related Evaporation	City of Cheyenne	Livestock	
1977	3,600	1,100	209,100*	8,000	1,200	223,000
1980						
With No Additional Coal Mines**	4,190	1,170	209,100	8,000	1,200	223,660
With Alternatives***	4,220	1,250	---	---	---	223,770
Amount Attributed to Alternatives****	60	80	---	---	---	110
% Increase Due To Alternative	1.4	6.8	---	---	---	0.05
1985						
With No Additional Coal Mines	5,040	1,200	209,100	34,000	1,200	250,540
With Alternative	6,060	2,180	---	---	---	252,540
Amount Attributed to Alternative	1,020	980	---	---	---	2,000
% Increase Due To Alternative	20	82	---	---	---	0.8
1990						
With No Additional Coal Mines	5,610	1,300	253,100	34,000	1,200	295,210
With Alternative	7,200	2,950	---	---	---	298,290
Amount Attributed to Alternative	1,590	1,490	---	---	---	3,080
% Increase Due To Alternative	28	125	---	---	---	1.0

* 1948 to 1968 average from Wyoming State Engineer; use rate has remained fairly constant. Figures are considered representative of current uses. Irrigation use was assumed to remain constant until Savery-Pot Hook project would be completed in the late 1980s.

** Projected use of water if none of the actions described for this alternative are implemented.

*** Projected use if the alternative is fully implemented.

**** The difference between uses for the two degrees of development is attributed to mining.

in the alternative would be: municipal use in the region—1,590 ac ft/yr; municipal use in Rawlins—990 ac ft/yr; industrial use in the region— 1,490.

The Rawlins water supply system would be badly stressed by the high level development which would cause water use in the city to be 25% greater than it would be with no additional coal mining. The city would have to enlarge the system and locate new water sources.

The municipal and industrial (M & I) water would be equal to 5% of the groundwater in storage and about one-third of the annual recharge. This water would not be available for other uses. The alternative would increase total water use in the region by 1%. Impacts on other users would be minimal and very localized as described in Chapter 4.

The high level alternative would cause domestic sewage in Rawlins to be greater than the design capacity for the new treatment plant, which is to be operational in the fall of 1979. The plant is designed for a population of 23,000; the population under the high level scenario would be over 25,000 by 1990. Overloading the treatment plant could cause incomplete treatment and the amount of effluent discharged would be sufficient to allow significant amounts to reach the North Platte River. About twice a year, releases of up to 5,700 gallons per minute (gpm) might be required for a period not exceeding 28 days (personal communication, Nelson Engineering 1978). This amount would be about six times greater than the present flow rate of Sugar Creek. The effluent from the new plant would be of better quality than that now released to Sugar Creek. The biological oxygen demand (B.O.D.) in effluent from the new plant would be about one-eighth of the B.O.D. in the present effluent. There is a strong potential for the water to pick up minerals that have been deposited along the creek in the past. Poor quality effluent has been released to Sugar Creek for many years and large deposits of mineral salts exist along the creek northeast of Rawlins and north of Sinclair. There is no way of comparing the amount of mineral salts that would reach the North Platte River with the amount that now reaches the river, but the Wyoming DEQ (personal communication) have stated that they foresee no measurable impact on the North Platte River and Seminoe Reservoir if the new treatment plant were to operate at full design capacity.

Groundwater

Impacts of mining on the quantity and quality of water supplies would be determined by the locations at which mining occurred and would differ among parts of the region.

Mining along the Atlantic Rim and the Continental Divide to the north would disturb up to 10% of the principal recharge area for the eastern part of the Washakie Basin. In small areas along ridge crests, recharge would be prevented from reaching the aquifers and in other areas, especially along Separation Creek, water moving through the aquifers would be intercepted by mine pits, thus preventing it from reaching down gradient wells and springs. Permits would be required from the State Engineer before any water could be intercepted.

Up to 20% of springs used by stock and wildlife could be destroyed either by being mined out or dewatered. New sources of water such as wells or surface water reservoirs would be required if the number and areal spacing of watering spots were to be maintained at satisfactory levels for animal survival. Detailed information on aquifer characteristics, pumping locations, and pumping schedules would be required in order to determine which springs would be affected, and the number of animals using each water source must be determined before specific impacts such as the number of animals displaced and cost of replacing water sources could be determined.

To the west of Separation Creek, especially in the Red Desert, mine pits would intercept little or no water. If a mine happened to be so located as to destroy one of the widely spaced springs, it could have a fairly large impact on water supplies because each supply is critical in an area where there are so few sources of water. Otherwise, mines in that area would have little or no impacts on the hydrologic balance on water related economy of the region.

Some companies are interested in underground mining in Carbon Basin and near Savery. Aquifers in Carbon Basin are partially isolated from the regional groundwater system by a layer of shale (Figure R8-2). Although the mines may intercept groundwater at a rate of 10 to 15 gpm; the impact would not extend beyond the basin and there would be little economic impact on any other use.

Underground mining in the Savery area could cause significant impact on the hydrologic balance, but aquifer characteristics are too poorly defined for a quantified analysis. At present, only the types of impact can be predicted. Mines would drain aquifers that now maintain the base flow of perennial streams. The drainage could be increased by fracturing from subsidence. Severe fracturing could even cause the streams to loose water into the mine. If mine drainage were disposed of in Savery Creek, as appears likely, the effect would be to decrease the base flow upstream from the mine and to temporarily increase the streamflow downstream. Eventually, as the aquifer was dewatered, streamflow would decrease along the entire stream and perennial streams could become intermittent, (having periods of no flow). Settling ponds required by SMCRA and Wyoming state regulations for treatment of water released to streams could cause up to 50% of the water to be evaporated, thus further decreasing the stream flow.

Depletion of streamflow from Savery Creek or Little Snake River would have a serious impact on farming along the Little Snake River Valley where surface water is used for irrigation. It would also be detrimental to municipal supplies. Any depletion of streamflow would be governed by the Colorado River Compacts and would require a permit from the state.

Underground mining does not appear compatible with the proposed Savery-Pot Hook irrigation project. Because the coal seams underly the routes and sites pro-

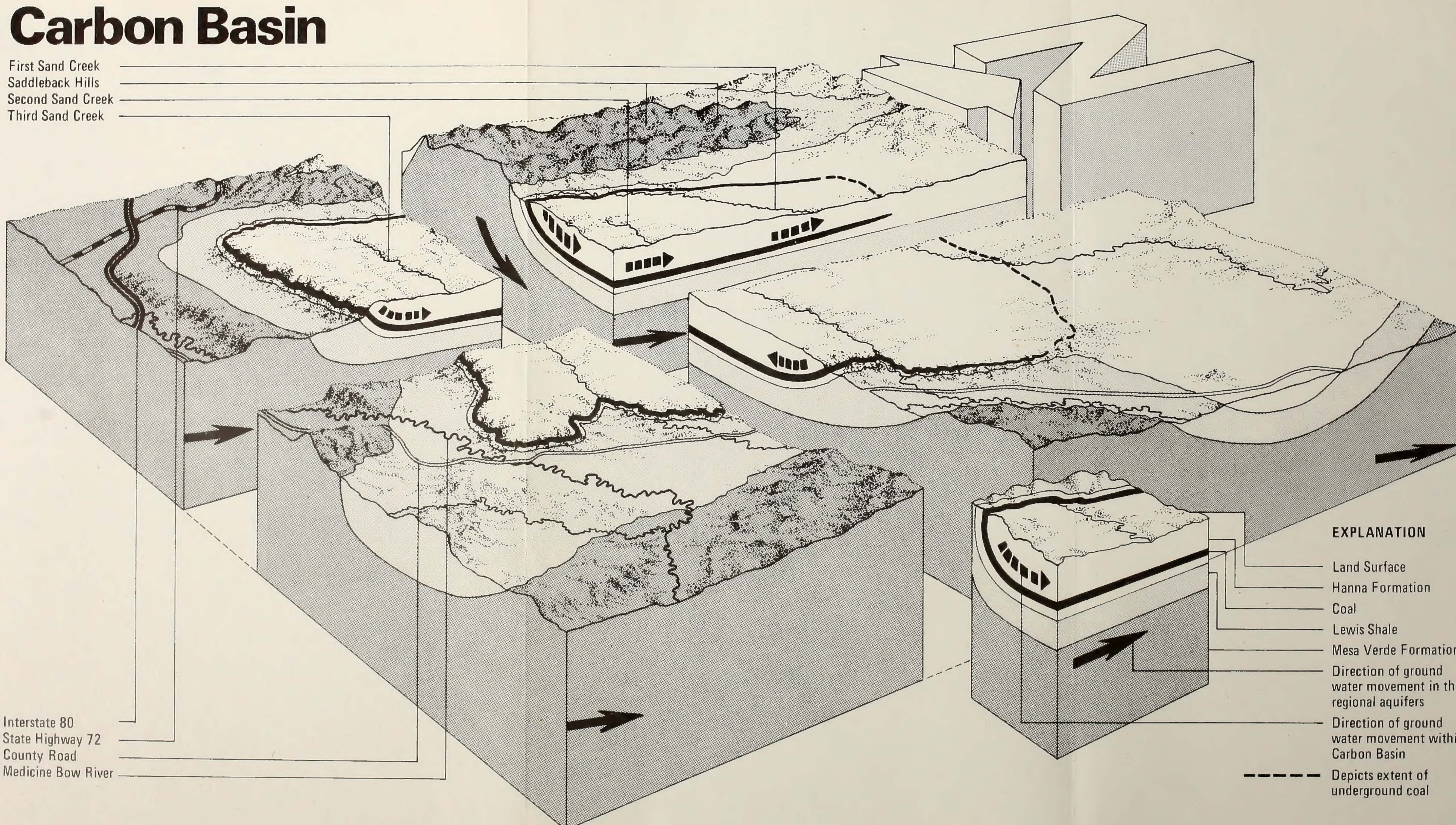


Figure R8 - 2
ISOMETRIC AQUIFER SYSTEM OF CARBON BASIN

posed for irritagion canals and dams, blasting and subsidence could damage such structures.

Surface Water

Outside of the impacts discussed above for the Savery area, there would be little impact on surface water.

Head water drainage areas of 15 to 20 small first and second order ephemeral streams in the Hanna area and 30 to 40 similar streams in the Overland area would be disturbed by mining and haul roads. Most of the streams drain less than 100 acres, the largest drains about 3 square miles. Disturbing these streams would have no significant impact on the hydrologic balance or the economy of the region. The amount of surface runoff from the small drainages that might be intercepted by all mines is less than 100 ac ft/yr in the Hanna area and possibly as much as 200 ac ft/yr in the Overland area. Another few hundered ac ft/yr would be intercepted by sediment settling basins and flood control reservoirs on five or six larger streams.

The amount of runoff that would be intercepted is small in comparison to total runoff of the region. After mining, the streams would be restored approximately to their present state. Water that would be intercepted contributes little to the existing water resources of the area, because it is now lost through evaporation from stream channels and would not be available for use even without the mines. Therefore, interception of surface runoff by mine pits would have no impact on the region. The settling basins and reservoirs would make water more accessible and would provide new watering spots for livestock and wildlife.

Quality

The potential for increased mineralization of groundwater is small because most of the mining would occur where aquifers are discharging water rather than receiving recharge. In those areas that do receive recharge, the amount of recharge is small in relation to amount of water moving through the ground, thus permitting mineralized water to be diffused and diluted in the aquifer. Atlantic Rim is the only area where a known recharge area would be disturbed. Water from this recharge area appears at the base of Atlantic Rim as springs, which are used by wildlife and livestock, and supplies some low-yield stockwater wells. Recharge may also occur along the Continental Divide north of Atlantic Rim. Even at locations where recharge does occur, little impact from mineralization is expected because; (1) only 10% to 15% of the total recharge area would be disturbed, (2) harmful elements have not been found in the overburden in large enough quantities to cause problems, (3) few of the minerals that are found in the overburden would become more soluable after mining, and (4) the low precipitation makes it unlikely that sufficient minerals would be added to the groundwater to impair its present use by animals. Mineralization of surface flow is not likely because Wyoming state law requires surface discharge to have fewer milligrams per liter (mg/l) of dissolved solids than natural streams.

The potential for acidic water is particularly low in the region because waters are highly alkaline, and iron pyrite, sulfur, and other acid-producing minerals are found in very low concentrations.

Selenium and uranium are found in some parts of the geologic formations that would be disturbed. There is only a remote possibility that these elements could be introduced into the groundwater of the Hanna and Overland areas because the elements have not been found in overburden in those areas. The greatest potential for both introduction of the elements and harmful effects would be near Savery where large deposits of selenium exist. Water from Savery Creek and Little Snake River is used for municipal supply in Savery, Baggs, and Dixon and for irrigation of pastures and croplands.

Crops grown on land irrigated with water containing selenium could transmit selenium to animals and humans. Selenium poisoning causes diseases of skin, hair, and nails in humans and blind staggers in cattle and sheep (Rosenfeld and Beath 1964). Concentrations of 5 mg/l in common foods or 0.5 mg/l in milk and drinking water are potentially dangerous to humans. Acute selenium poisoning in animals usually occurs from consumption of large amounts of seleniferous weeds, but less acute poisoning occurs when seleniferous crops are consumed for long periods. Detailed studies of levels, movement, and quality of groundwater, both above and below the proposed mining levels, would be required before the true potential for selenium poisoning could be assessed.

Sediment

Source yields (the amount of sediment moved by overland runoff from small plots of ground) would be greater from mine spoils than from undisturbed soil, but would be only remotely related to amount of sediment that would be transported by streams. Several hydrologic and legal requirements discussed in Chapter 4 would combine to reduce the transport and impacts to a very low level. The small amounts of sediment transported would cause little regional impact because the ephemeral streams draining the mine areas have no fisheries, riparian habitat, or man-made developments that could be affected. Under SMCRA sediment generated in mine areas would be retained in settling basins.

Sediment from cuts and fills along roads, railroads, and power lines would not have a significant impact on the region. Any impact that did result would be confined to local areas within a mile of the sediment source. There is seldom sufficient runoff to transport the sediment beyond that distance, and as stated above, nothing exists that can be harmed by sediment. Locally, stream gradients of 20 to 30 ephemeral streams crossed by transportation and power facilities could be altered as sediment was deposited upstream from culverts and erosion occurred downstream, but again, there would be no regional impact.

Vegetation

Terrestrial

A cumulative total of 34,473 acres of vegetation is projected to be disturbed by developments under the high level alternative by 1990. Developments under this alternative include the proposed actions, continuation of existing mines, development of areas of interest containing coal, other energy related resource development, the Savery-Pot Hook project, and acreage utilized as housing and support service sites for the increased population. The acreage disturbance expected by other time periods would be 3,403 acres by 1980 and 19,379 acres by 1985.

Vegetative disturbance would begin on the proposed projects by mid 1979 in the Hanna area. By 1980, a total of 886 acres would be disturbed. During the 1981 to 1985 period, development would continue in the Hanna area and be initiated on the one project in the Divide area. Cumulative vegetative disturbance during this time period would be 4,257 acres. In the 1986 to 1990 period, development of the Hanna area proposed projects would be completed and would continue in the Divide area. Cumulative vegetative acres disturbed by 1990 on the proposed projects would be 5,904 acres (Table R4-5).

The vegetative disturbance that would occur on the existing mines in the Hanna area would be confined to the actual mining area since the mine and ancillary facilities needed to service the mine are already in place. Cumulative acreage of vegetation disturbed by the existing mines would be 1,837 acres by 1980; 6,080 acres by 1985; and 10,370 acres by 1990 (Table R4-5).

Areas containing minable coal that have been identified and are of interest to develop are located throughout the ES region. The development of mines on these areas at the earliest possible date would result in an estimated cumulative vegetative disturbance of 7,471 acres by 1985 and 15,713 by 1990 including acreage required for urban needs.

The cumulative acreage of vegetation disturbed by all coal related activity including acreage to meet population needs would be 2,723 acres by 1980; 17,808 by 1985; and 31,987 acres or .6% of the ES region by 1990.

Combined oil, gas, uranium, sand and gravel activities, and development of the Savery-Pot Hook project would disturb 680 acres by 1980; 1,571 acres by 1985; and 2,486 acres by 1990.

It is expected that the yearly acreage of land reclaimed would be equal to that mined within 2 years after a mine is started on the proposed sites and areas of interest and would be an ongoing program on the existing mines. The average acreage that would be disturbed each year would be approximately 384 acres on the proposed projects; 855 acres on the existing mines; and 1,460 acres on the areas of interest. It is estimated that the amount of unreclaimed disturbed acreage on mine sites in the ES region would not exceed 2,478 acres from the present to 1980 and 5,398 acres from 1981 thru 1990. Owing to climatic conditions and soil characteristics of the area, it is assumed that reclaimed areas would not attain adequate vegetative cover of any type until 7½ years after initiation of reclamation efforts. With this premise, it is estimated that the total acreage at any one time that would not have adequate vegetative cover would not exceed 8,054 acres from the present to 1980 and 17,540 acres from 1981 thru 1990. These acreage would be composed of approximately 31% of unreclaimed disturbed lands and 69% reclaimed (topsoil replaced and seeded) lands in various stages of vegetative establishment, but still unable to sustain any use of the vegetation. Reclamation problems expected under this alternative would be the same as those outlined in Chapter 4.

Other impacts that would occur under this alternative would be identical to those of the proposed actions and are unquantifiable. The only difference would be in the magnitude of the impact as it related to the amount of disturbance. Refer to Chapter 4, Vegetation for identification of these unquantifiable impacts.

Aquatic

All of the proposed mining locations, existing mines, and all areas of interest except those in the Savery area are drained by ephemeral streams that flow at limited times such as during spring runoff and after intensive summer rainstorms. Owing to the ephemeral characteristics of the drainages and in view of erosion control measures outlined in the mining plans, the impact on aquatic vegetation from these sites is expected to be minimal.

The area of interest in the Savery area and the Savery-Pot Hook project would affect the aquatic vegetation of the Little Snake River and Savery Creek. The impacts on the aquatic vegetation expected from these developments are impossible to evaluate at this time since no information is available concerning the quantity or quality of aquatic plant life in these streams.

Endangered and/or Threatened

There is no record of any endangered or threatened plant species in the ES region, and it is concluded that the chance of any such plants being present on any of the possible coal development areas is near zero (reference, Chapter 2).

Fish and Wildlife

Coal operations in this alternative would remove an estimated 2,723 acres of wildlife habitat by 1980; 17,808 acres by 1985; and 31,987 acres by 1990. Other energy related activities would remove an additional 680 acres by 1980; 1,571 acres by 1985; and 2,486 acres by 1990. Total acres of wildlife habitat lost to this alternative would total an estimated 3,403 acres by 1980; 19,379 acres by 1985; and 34,473 acres by 1990. Estimated losses of actual acreages of various vegetative types that would be removed are not available since data concerning exact

locations of future energy related activities are not presently obtainable.

Coal related losses of wildlife habitat would total an estimated 0.05% of the total habitat in the region by 1980, 0.3% by 1985, and 0.6% by 1990. All energy related activities would remove an estimated 0.06% of the total regional wildlife habitat by 1980, 0.4% by 1985, and 0.63% by 1990.

Losses with varying degrees of severity would occur to wildlife populations inhabiting areas where these energy related activities are planned to take place. These losses are not quantifiable at the present level of knowledge, but would constitute a very low percentage of each population within the region. In certain of the project areas, losses would be significant for the population in the immediate vicinity of the mine, but again, would be a very small percentage of the regional total.

Endangered and/or Threatened

Under Section 7 of the Endangered Species Act of 1973, all areas would be cleared of any possible conflict with any species listed under this act. No adverse impact would be allowed to occur to any species listed under this act. Impact to golden eagles and bald eagles will not be allowed to occur according to provisions of the Bald Eagle Act of 1974 as amended.

Cultural Resources

Under the high level of coal development, cultural resources could be impacted by the continued development of existing mines, the proposed actions, development of areas of coal interest, and other non-coal related development in the region. Since BLM compliance procedures require cultural resource surveys and other mitigating measures, the only cultural sites which might be impacted would be those subsurface sites missed during intensive cultural resource surveys. Those potential impacts are not quantifiable.

Recreation Resources

More people would travel to the area for recreation (see Table R8-16). The increased use would have two basic impacts. It would reduce the quality of the outdoor recreation experience which is found in the region, and there would be more conflicts between recreationists and landowners due to increased numbers of people crossing private land. This would prompt landowners to restrict access to and across their private land.

Agriculture

Livestock Grazing

The development of coal reserves and other energy related resource under this alternative would lead to changes in land use. These changes would ultimately be at the expense of grazing lands since grazing is the dominant use in the area.

The construction of the mines and ancillary facilities on the proposed projects and areas of interest and the continuation of existing mines, but excluding acreage utilized in housing and support service development, would result in the removal of vegetation of approximately 32,928 acres of rangeland by 1990, which would be .60% of the ES area of 5.5 million acres. Acreage of vegetation removed at the end of other benchmark periods would be 3,203 by 1980 and 18,011 by 1985. The disturbance of vegetated acres would impact approximately thirteen ranch operators who own land and lease public lands for grazing in the project areas. The degree of impact on each ranch operation would vary greatly due to location of individual holdings (owned and leased) in relation to the prospective development lands. The magnitude of the impact would also vary with the rate and timing of development of a mine, especially if more than one mine is proposed for development on an individual allotment. The magnitude of the impact cannot be quantified since data concerning size of ranch operations impacted are not available.

The disturbed lands are expected to attain full production at the same rate as mining lands are developed, beginning 7½ or more years after reclamation efforts are intitiated. The approximate acreage that would be unable to support grazing would vary from 8,054 to 17,540 acres at any one time depending on rate and time of development. Grazing loss would vary in like manner from 805 to 1,754 animal unit months (AUMs) annually.

Other impacts that would occur under this alternative would be identical to those due to the proposed action and are unquantifiable. The only difference would be in the magnitude of the impact as it related to the area involved. Refer to Chapter 4, Agriculture for identification of these impacts.

Farming

There is no cropland located within or adjacent to any of the proposed mining sites, existing mines, or the areas of interest except those in the Savery area.

The development of the area of interest in the Savery area would result in the loss of 125 acres of hayland which has a production capability of approximately 315 tons of hay per year and 65 acres of pastureland with a carrying capacity of approximately 14 AUMs. The loss of this production would effect one ranch operation in the Savery Creek Valley.

The development of the Savery-Pot Hook project would result in the destruction of 366 acres of vegetation on the reservoir site, 22 acres for fence construction, and 217 acres in the construction of canals and laterals. Changes in land use would occur on 6,590 acres of land composed of 5,390 acres of sagebrush and 1,200 acres of

Table R8-16

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO
POPULATION CHANGE FOR YEARS 1980, 1985, 1990

	Fishing	General**	Hunting (Big Game)	Off-Road Vehicles	Urban Recreation***	Water Sports****	Winter Sports*****
1977	76,893	98,705	28,476	2,957	46,949	35,489	9,427
1980 (population 161)*							
without 22,201 proposed action	93,670	120,339	28,872	3,526	60,169	44,300	12,343
increase due to proposed action	684	879	211	26	440	324	90
total projection	94,354	121,218	29,083	3,552	60,609	44,624	12,433
% of projection due to proposed action	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
1985 (population 5,972)*							
Without 32,506 proposed action	114,892	149,917	34,494	4,245	78,806	56,518	16,982
increase due to proposed action	25,859	33,742	7,764	956	17,737	12,720	3,822
total projection	140,751	183,659	42,258	5,201	96,543	69,238	20,804
% of projection due to proposed action	18.4%	18.4%	18.4%	18.4%	18.4%	18.4%	18.4%

Table R8-16
(Continued)

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO
POPULATION CHANGE FOR YEARS 1980, 1985, 1990

	Fishing	General**	Hunting (Big Game)	Off-Road Vehicles	Urban Recreation***	Water Sports****	Winter Sports*****
1990 (population 7,554)* 37,865							
without proposed action	132,762	175,197	39,405	4,849	94,874	66,987	20,611
increase due to proposed action	33,087	43,662	9,820	1,209	23,644	16,695	5,137
total projection	165,849	218,859	49,225	6,058	118,518	83,682	25,748
% of projection due to proposed action	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%

* Population changes due to project (socioeconomic section)

** General includes camping, picnicing, sightseeing, etc.

*** Urban includes rodeos, golfing, and attending athletic events

**** Water sports include boating, swimming, and water skiing

***** Winter sports include only skiing

cleared (dryland farming) lands. This acreage would be designated full service irrigation land and would be put under intensive management for hay or crop production. More intensive management would also be initiated on 10,690 acres of presently irrigated lands through the use of supplemental irrigation water. Increased production predicted for this project is 28,189 tons of alfalfa hay; 4,048 tons of native hay; and 302,950 bushels of grain. Livestock population would increase by 8,000 head of sheep and 12,000 head of cattle (Bureau of Reclamation 1976).

Mineral Resources

Cumulative amounts of sand and gravel needed for housing and mine facilities construction would be 21,000 cubic yards by 1980; 91,000 cubic yards by 1985; and 122,000 cubic yards by 1990. The impact of this loss is not known as regional reserves are not known.

Cumulative amounts of scoria needed would be 50,400 cubic yards by 1980; 270,800 cubic yards by 1985; and 447,600 cubic yards by 1990. Sand, gravel, and scoria operations would disturb a total of 38 acres. The impact of this loss is not known since the regional reserves are not known.

Approximately 317 million cumulative tons of coal would be mined by 1990, or 0.6% of the Wyoming coal reserves. Approximately 78.7 million tons would be lost due to mining methods and would not be recoverable.

Socioeconomics

The high level of coal development (plus uranium, oil and gas, etc.) would lead to a regional population total of 37,031 by 1990. Of this, 7,501 (20%) would be due to coal development only (Table R8-17).

By 1990 employment would increase by 3,534 with the high level development to a total employment level of 16,636 (Centaur 1978). Because unemployment in the region is very low (3.0% in 1977 compared to 7.0% nationwide), there would not be sufficient "slack"in the economy to absorb the increases in mine employment. Mining and construction workers receive higher wages than employees in other sectors of the economy, so the new mine employment would likely cause a shortage of workers in these other sectors. Since such a large number of employees would be needed for the mines, mining companies would go directly to labor markets outside the region (e.g., Denver) to hire employees, thus bypassing the limitations of the local economy. This would begin in the early 1980s. It would take until the early 1990s for the economy to fully adjust to this influx of mining employees.

At that time total employment growth would reach 4,491 or 27% greater than the number of additional workers in 1990 (Centaur 1978).

Total personal income would rise from $147.1 million (in constant 1977 dollars) in 1977 to $502.1 million (in constant 1977 dollars) by 1990. Of this, $129.8 million would be due to the high level of coal development. Some $69.3 million would be gained in the mining sector alone (Centaur 1978).

Sales in retail trade and services would increase from $61.8 million in 1977 to $210.9 million (all in constant 1977 dollars) by 1990. The high level of coal development would account for $54.5 million (26%) of the 1990 total. Rawlins would be expected to have the largest increase in sales because of its role as the major retail trade center in Carbon County and because the largest proportion of the additional population is expected to live there (Centaur 1978).

With the high level of coal development, Carbon County would find itself in a more improved condition financially than if the development did not occur. Likewise, School Districts 01 and 02 would also benefit from the coal development through increased tax bases. However, School District 01 would still be in a deficit position while District 02 would have a considerable surplus. The various communities in the region would find themselves in a worsened position financially. This is because the mines would be located outside of town (contributing no property taxes to the town), but the town would be required to provide services to the employees that live there.

Total housing demand would increase from a 1977 total of 6,697 to a total of 13,796 by 1990. Coal development would account for 2,947 (21%) of this demand (Centaur 1978).

School age population in School District 01 would increase from 3,292 in 1977 to 7,974 in 1990. Of this, 1,725 would be due to coal development. In School District 02, school age population would increase from 1,646 in 1977 to 2,433 in 1990. Coal development would be responsible for 330 of this (Centaur 1978).

Future needs for health care specialists would worsen significantly in the high level of coal development. The total number of physicians needed in 1990 would be 37, 8 of which would be as a result of the coal development. The Memorial Hospital in Rawlins has a capacity to serve a population of 29,000 to 33,000. The additional 7,501 people that would come into the region due to the high level of coal development would contribute to the hospital becoming inadequate between 1980 and 1985. By 1990 the hospital would be operating at 112% of capacity (Centaur 1978).

Congestion on local access roads would occur with the high level of coal development. This would be expected at the time of shift changes. The highways in Wyoming currently operate during their most heavily traveled times at 30% to 40% capacity. The traffic generated as a result of the high level of coal development would not be expected to adversely affect the carrying capacity of the roads (Mabie 1978). No change in the types of passenger transportation currently available would be expected due to the coal development.

The increase in unit coal trains originating in the region would not cause serious adverse impacts in the larger southcentral and southeastern Wyoming communities along the Union Pacific main line. Due to the accessibility of grade separations (overpasses or underpasses),

Table R8-17

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

County City	1977 Total Population	Total Without the Proposed Alternative	Total With the Proposed Alternative	Cumulative Impact	Impact of the Proposed Alternative
			1980		
Carbon County*	18,137	21,577	21,736	3,601	161
Rawlins	10,500	13,263	13,336	2,836	73
Sinclair	550	560	562	12	2
Hanna/Elmo**	1,500	1,813	1,864	364	51
Elk Mountain	220	242	246	26	4
Medicine Bow	750	850	861	111	11
Saratoga	2,050	2,149	2,165	115	16
Encampment	500	529	533	33	4
Baggs Area***	465	465	465	0	0
Wamsutter (Sweetwater County)****	347	463	463	116	0
			1985		
Carbon County*		25,903	31,808	13,671	5,905
Rawlins		16,872	21,133	10,633	4,261
Sinclair		569	701	151	132
Hanna/Elmo**		2,128	2,526	1,026	398
Elk Mountain		263	349	129	86
Medicine Bow		918	1,239	489	321
Saratoga		2,249	2,487	437	238
Encampment		556	565	65	9
Baggs Area***		465	925	460	460
Wamsutter (Sweetwater County)****		631	698	351	67
			1990		
Carbon County*		29,530	37,031	18,894	7,501
Rawlins		19,959	25,171	14,671	5,212
Sinclair		576	710	160	134
Hanna/Elmo**		2,347	2,812	1,312	465
Elk Mountain		275	374*****	154	99
Medicine Bow		966	1,343	593	377
Saratoga		2,316	2,596	546	280
Encampment		577	586	86	9
Baggs Area***		465	1,390	925	925
Wamsutter (Sweetwater County)****		781	834	487	53

See notes on following page.

Table R8-17 (Cont.)

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

Note: Cumulative impact represents the difference between total population with the proposed alternative and the 1977 population estimate. The impact of the proposed alternative is the difference between total population with the proposed alternative and total population without the proposed alternative.

*In addition, population in Rock River (Albany County) would be increased by 55 in 1985 and 65 in 1990 and population in Craig, Colorado would increase by 610 in 1990. The population of Rock River was 344 at the time of the 1970 Census and the population of Craig was 6,677 at the time of a 1977 Special Census.

**These towns are located several miles aprat and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

***This includes Baggs, Dixon and the unincorporated community of Savery with population of perhaps 25.

****Population growth in Wamsutter results from uranium mining activity in the Red Desert area. Energy projects to the west of Wamsutter (in the Rock Spring Area) may result in additional growth in Wamsutter's population beyond the estimates shown here.

***** The Projections of Elk Mountain's population have assumed that no major housing developments would take place. Such developments would require major water system improvements and installation of sewer collectors and a sewage treatment facility. (Elk Mountain presently relies on Septic Tanks.) However, several subdivision plats have been approved, and major developments could occur. With major developments, population in Elk Mountain would grow much more rapidly than shown, perhaps reaching 600-700 by 1990.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming Resources Research Institute, Laramie, 1978. Totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

residents in the more densely populated areas of Rawlins, Laramie, and Cheyenne would be able to circumvent train traffic and thus avoid vehicle and pedestrian traffic delays. Two smaller communities, Rock River in Albany County and Pine Bluffs in Laramie County, would need grade separations to handle the anticipated train volume. Other adverse impacts such as physical separation of parts of town or noise and air pollution would occur to a greater degree; however, local community officials do not expect these impacts to be severe (Nelson 1978; Hawes 1978; Grunkemeyer 1978; Ivanson 1978). In Nebraska, the increase in rail traffic would aggravate an already serious vehicle and pedestrian transit problem. Currently, rail traffic causes delays and inconveniences in a number of Nebraska communities. The projected increase even without the coal development would place a severe burden on the communities of Sidney and Grand Island, Nebraska and Julesburg Colorado if grade separations are not constructed.

The projected increase of approximately 8 unit trains per day in 1985 would represent 11% of the projected total daily traffic. By 1990 the high level of coal development would add 12 trains per day or 15% of the 83 trains per day projected for that year (Figure R8-3). Based on railroad travel capacity figures of about 70 to 80 trains daily, the 1990 train volume would exceed current track capacity by a few trains per day. The increase would add to the problems of pedestrian and vehicle access routes, isolation of parts of town, pollution, and safety already occurring in Julesburg, Colorado and Sidney and Grand Island, Nebraska.

Residents opposed to continue growth and disturbance of the wide-open spaces would view coal development as a further aggravation of their position. In spite of the benefits (employment and income), they would resent the increased population and urbanization that would occur. Those persons who would benefit from the development directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages. Their positions would advance financially, and they would see the development as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions could see it further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining section (Abt Associates 1977; Gilmore 1974).

Lifestyles

The changes currently occurring in the lifestyles of Carbon County residents would continue with or without additional coal development. The additional development would reinforce and speed up those changes in the impacted portions of the region. The magnitude of the impact is not quantifiable.

FISH AND WILDLIFE MITIGATION ALTERNATIVE

This alternative lists recommendations which, if implemented, would greatly reduce or totally eliminate the major impacts to existing wildlife resources described in Chapters 4 through 7 by enhancement of the wildlife habitat and carrying capacities of those lands adjacent to the proposed mining operations or on nearby off-site locations.

Recommendations

1. That all mining areas be reclaimed to include wildlife habitat as soon as possible. Reclamation would be in conformance to the post-mining land use set out in BLM's land use plans for the area. Vegetative planting and reclamation should be accomplished in consultation with the Wyoming Game and Fish Department, Wyoming Department of Environmental Quality, and U.S. Fish and Wildlife Service. The goal of reclamation should be to achieve the highest possible wildlife carrying capacity at the earliest possible date using all possible tools to achieve this goal.
2. That an acreage deemed necessary to compensate the impacts be set aside as a mitigation area. This mitigation area would be made up of public lands on nearby off-site locations. Selection of this area should be accomplished in consultation with the Wyoming Game and Fish Department, BLM, and the U.S. Fish and Wildlife Service. This area would be managed intensively for wildlife.
3. That the mitigation area be managed to increase its wildlife carrying capacity an amount necessary to compensate impacts. Management tools such as water development, fertilization, vegetative manipulation, spraying, transplanting, seeding, protection of wildlife cover, and management of livestock grazing to enhance wildlife habitat should be implemented as necessary. The habitat of these mitigation areas should be managed by BLM and the wildlife by the Wyoming Game and Fish Department.
4. That mine permits will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for substitute mining practices, buffer zones, prey base, and alternate nest sites.

Resource Recommendations

1. All disturbed areas scheduled to be reclaimed should include the following browse species in the seeding mix; winterfat, fourwing saltbush, and little rabbit-

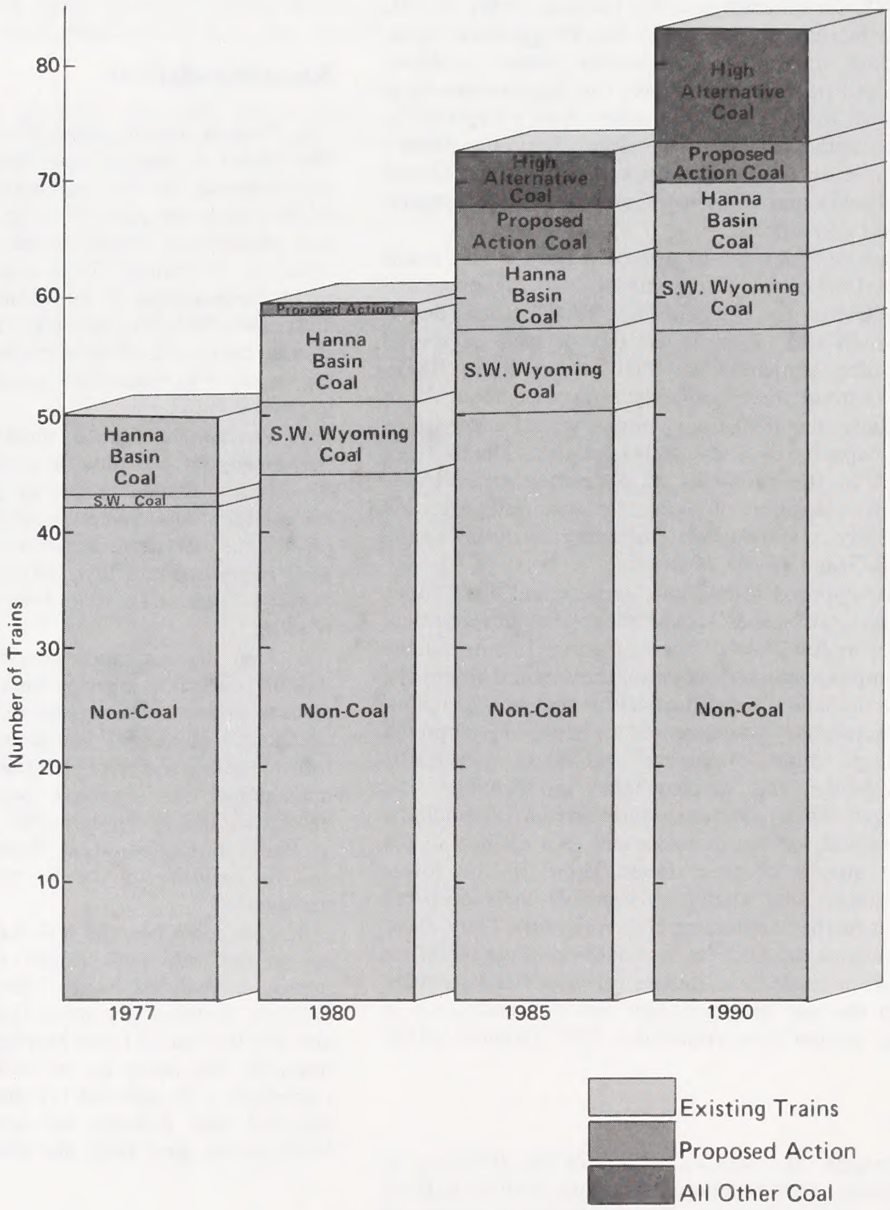


Figure R8-3
DAILY TRAIN TRAFFIC

brush. Seeding rates of these species should follow recommendations in Plummer et al. (1968).

2. Potted shrubs should be established in clusters behind snow fences so that protection and additional moisture afforded by the snow would increase the likelihood of shrub cover being quickly established.

3. Sage grouse strutting grounds that are located on mining areas should be moved using techniques now being developed on mine areas in southern Montana (personal communication, Eng 1978).

DEFER FURTHER FEDERAL COAL DEVELOPMENT PENDING DEMONSTRATION OF SUCCESSFUL RECLAMATION

Under this alternative, further federal coal development in the southcentral region would be deferred until it could be demonstrated that areas disturbed by mining activities can be reclaimed to the standards of the Surface Mining Control and Reclamation Act (SMCRA). This alternative is more specifically addressed for each proposed mine in the site-specific analyses (Chapter 8).

Past reclamation attempts in the region have had limited success for the reasons outlined in Chapter 2, Soils. To date, the Wyoming Department of Environmental Quality has not released any area as being satisfactorily reclaimed, although efforts have been in progress for several years.

It is estimated that an initial judgment on reclamation success in an area of ongoing effort could be made in 3 to 5 years. However, reclamation efforts would be monitored by the authorized agencies, and the final acceptance would be based on SMCRA standards.

Delaying federal coal development in this region would also change, but only slightly, the impacts discussed in Chapter 4. It could force intended purchasers of the coal find other sources. Impacts which would occur if revegetation could not be accomplished follows:

1. The mining company would be forced to shut down its operation on federal land.

2. A shut down of the mine would cause economic loss to the mining company from the sale of coal, loss of employment for most of the employees, and partial loss of investment in equipment and material needed to open and operate the mine.

3. Areas disturbed during the period of mining would be unreclaimed or at best only partially reclaimed.

4. The consumer of coal from the mine would need to obtain coal from another source.

5. The reduction in labor force would cause socioeconomic impacts to the region.

6. In the event that mining would still occur on nonfederal lands, the above impacts would be lessened but would still be significant.

CHAPTER 9

CONSULTATION AND COORDINATION WITH OTHERS

TEAM ORGANIZATION

The Wyoming State Director of the BLM was assigned the lead responsibility for preparation of this draft environmental statement. The primary interagency effort involved the BLM and the Geological Survey (GS). Subsequently, an approach for the effort was developed, including selection of team members and scheduling of actions to follow.

A team led by BLM was established representing broad categories of environmental concern including socioeconomics, soils, plants, animals, cultural resources, and recreation. The GS agreed to provide supportive skills in the form of mining engineering, hydrology, and geology. The U.S. Fish and Wildlife Service and the Bureau of Mines provided some support in their respective fields.

PUBLIC COMMENTS AND RESPONSES

On December 15, 1976, a public coal issues meeting was held at Jeffery Center in Rawlins to discuss proposed coal development in southcentral Wyoming. A coal issues brochure and two news releases were published to solicit attendance at this meeting and input to the environmental process. About 60 people attended and significant issues were raised at the meeting.

Representatives from the coal industry mentioned their need for assured coal supplies to meet their obligations to supply power generation facilities in other areas of the country. Agricultural representatives were concerned about the possible losses of agricultural land, water, and life style resulting from mining operations. Spokespersons for conservation organizations expressed concern over mining's possible impacts on local wildlife, overall environmental quality levels, as well as the real need for more coal leasing at this time. A third press release, dated January 24, 1977, was issued to encourage public comments.

Public hearings will be scheduled to receive comment on this draft environmental statement in Rawlins, Wyoming. News releases, Federal Register notices, and special postings will be issued on specific hearing dates.

Copies of this draft ES are available from the BLM Rawlins District Office and Cheyenne State Office upon request until supplies are depleted.

CONSULTATION AND COORDINATION IN THE PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

During preparation of this draft environmental statement, federal, state, county, and local agencies; private industry; and individuals and organizations with special expertise relating to the proposed actions were contacted to gain information and close data gaps. The substantive results of these consultation and coordination efforts follow. Those agencies which provided contract data or cooperated in preparation of the ES are not listed here, but are referenced elsewhere in the document.

Federal Agencies

U.S. Department of Agriculture (USDA), Forest Service

The Forest Service provided information on range and timber types, snow hydrology, soil types, recreation use, and wildlife distribution within the Medicine Bow National Forest. The Shrub Science Laboratory in Provo, Utah provided information on reclamation methods.

USDA, Agricultural Stablization and Conservation Service

The ASCS provided information about land use patterns on private lands in the county and a copy of the 1974 census of agriculture.

USDA, Soil Conservation Service

The Upper Colorado Enviornmental Plant Center (Douglas Creek and White River Conservation Districts, Rio Blanco County) provided information on reclamation procedures and success. The SCS in Boseman, Montana also provided information on these subjects.

U.S. Department of the Interior (USDI), Bureau of Outdoor Recreation

The BOR provided information on the proposed Continental Divide Trail. (The Bureau of Outdoor Recreation is now the Heritage Conservation and Recreation Service.)

USDI, Bureau of Reclamation

The Bureau of Reclamation provided information on the possible relationship between mining and Seminoe Reservoir.

Environmental Protection Agency

The EPA provided tabulations of water quality data.

State Agencies

Wyoming Recreation Commission, State Historic Preservation Officer

The office of the SHPO provided information on historic sites and a listing of National Register sites.

Wyoming State Parks Division

The State Parks Division provided information on recreational use at Seminoe State Park.

Wyoming Department of Agriculture

The Department of Agriculture provided information on agricultural water use.

Wyoming State Engineer

The State Engineer's office provided information on water studies, water rights, and water decrees.

Wyoming Department of Environmental Quality

The DEQ provided information on water quality, air quality, and reclamation.

Wyoming Geological Survey

The state geological survey provided information on the relationships between coal and other energy minerals in southcentral Wyoming.

Wyoming Highway Department

The Highway Department provided information and maps on the transportation system in the region.

County and Local Entities

Carbon County Planning Commission

The planning commission provided data on zoning within the county.

Carbon County Assessor's Office

The assessor's office provided information on the number of livestock in the county.

Sweetwater County Planning Office

The planning office provided information on zoning within the county.

City of Rawlins

The city provided information on present water supply and future development.

Private Industries

Pacific Power and Light Company

The company provided information relating to the locations of power lines, and water use, and water availability.

Robert Jack Smith and Associates

The firm provided information on the locations of power lines.

Colorado Interstate Gas

The company provided information on locations of pipelines.

Rocky Mountain Energy Company

The company provided information on mining procedures and water use.

Sinclair Pipeline Company

The company provided information on the locations of pipelines.

AMOCO Pipeline Company

The company provided information on pipeline locations.

Union Pacific Railroad

The company provided information of diesel fuel consumption and train traffic.

Mountain Bell

The company provided information on the locations of telephone lines.

Individuals and Organizations

Mrs. Pat Payne and Mrs. Elva Evans of Saratoga, Wyoming provided information on the Wolf Hotel in Saratoga. Mr. Norm Palm of Elk Mountain, Wyoming provided information on livestock management practices in the Hanna area. Mrs. Frank Dunben of Baggs, Wyoming provided information on Baker's Cabin. Mr. Bill Clark provided information on Fort Steele.

University of Wyoming

Various persons at the university provided information on climate, paleontology, range research, and water.

Montana State University

Various persons at the university provided information on mine reclamation research.

University of Utah

Various persons at the university provided information on seismicity in Wyoming.

Eastern Kentucky University

Various persons at the university provided information on space standards for parks.

Colorado Division of Wildlife

The division provided information on sage grouse research.

Montana Fish and Game Department

The department provided information on sage grouse research.

COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

Comments on the draft environmental statement will be requested from the following agencies, state clearing houses, and interest groups.

Federal

Advisory Council on Historic Preservation
Department of Agriculture

- Soil Conservation Service
- Forest Service

Department of Commerce
Department of Energy
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior

- Bureau of Mines
- Bureau of Reclamation
- Fish and Wildlife Service
- Heritage Conservation and Recreation Service
- National Park Service
- Office of Surface Mining

Department of Labor

- Mining Safety and Health Administration
- Occupational Safety and Health Administration

Department of Transporation
Environmental Protection Agency
Federal Energy Regulatory Commission
Interstate Commerce Commission
Mountain Plains Federal Regional Council
National Historic Preservation Council
Office of Economic Opportunity
Office of Management and Budget
Water Resources Council

State

The State of Wyoming Clearing House will coordinate comments from all interested agencies.

Local

Carbon County Commissioners
Carbon County Council of Governments
Sweetwater County Commissioners
Sweetwater County Zoning and Planning Commission
City of Rawlins
Town of Hanna
Town of Saratoga
Town of Baggs
Town of Encampment
Town of Sinclair
Town of Wamsutter
Town of Medicine Bow

Nongovernmental Organizations

Alpine Chapter, Audubon Society
American Horse Protective Association
American Electric Power Service Corporation
Amercian Institute of Mining Engineers

American Mining Congress
American Sportsman's Club
Carbon County Woolgrowers
Defenders of Wildlife
ENACT

Environmental Citizen's Lobby
Friends of the Earth
International Society for the Protection of Mustangs and Burros
Izaak Walton League
League of Women Voters
National Audubon Society
National Coal Association
National Council of Public Land Users
National Energy Law and Policy Institute
National Environmental Health Association
National Resources and Environmental Council
National Wildlife Federation
Natural Resources Defense Council
Northern Great Plains Chapter, Sierra Club
Powder River Basin Resource Council
Society for Range Management
The Wilderness Society
Trout Unlimited
Wild Horse Organized Assistance
Wyoming Outdoor Council
Wyoming Petroleum Association
Wyoming Woolgrowers
Wyoming Stockgrowers Association
Wyoming Wildlife Federation

WHERE COPIES MAY BE INSPECTED

Bureau of Land Management

Buffalo Resource Area
Buffalo, Wyoming 82834
(307) 684-5586
Casper District Office
951 Union Blvd.
Casper, Wyoming 82601
(307) 265-5550
Cody Resource Area
1131 13th St.
Federal Building
Cody, Wyoming 82414
(307) 587-2216
Denver Service Center Library
Bldg. 50, Denver Service Center
Denver, Colorado 80225
(303) 234-4578
Kemmerer Resource Area
Diamondville, Wyoming 82116
(307) 877-3933

Lander Resource Area
Lander, Wyoming 82520
(307) 332-4220
Newcastle Resource Area
Highway 16 Bypass (P. O. Box 757)
Newcastle, Wyoming 82701
(307) 746-4453
Pinedale Resource Area
Molyneux Building
Pinedale, Wyoming 82941
(307) 367-4358
Rawlins District Office
1300 - Third Street
Rawlins, Wyoming 82301
(307) 324-7171
Rock Springs District Office
Highway 187N
Rock Springs, Wyoming 82901
(307) 382-5350
Washington Office of Public Affairs
18th and C Street
Washington, D.C. 20240
(202) 343-4151
Worland District Office
1700 Robertson Avenue
Worland, Wyoming 82401
(307) 347-6151
Wyoming State Office
2515 Warren (Lea Building)
Cheyenne, Wyoming 82001
(307) 778-2220 Ext. 2385

Geological Survey

District Mining Office
Federal Building
Casper, Wyoming 82601
(307) 265-5550
Director's Office National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092
(703) 860-7411
District Mining Supervisor's Office

126 Elk Street (Rear)
Rock Springs, Wyoming 82901
(307) 362-7350
Regional Manager's Office
7200 W. Alameda Avenue (Villa Italia)
Lakewood, Colorado 80226
(303) 234-2855
Area Mining Supervisor
Building 25
Denver Federal Center
Denver, Colorado 80225
(303) 234-4435

Public Libraries

Albany County Library
405 Grand Avenue
Laramie, Wyoming 82070

CONSULTATION AND COORDINATION

Carbon County Library
Courthouse
Rawlins, Wyoming 82301
Casper College Library
125 College Drive
Casper, Wyoming 82601
Encampment Branch Library
Encampment, Wyoming 82325
Fremont County Library
451 North Second Street
Lander, Wyoming 82520
Laramie County Community College Library
1400 East College Drive
Cheyenne, Wyoming 82001
Laramie County Library
2800 Central Avenue
Cheyenne, Wyoming 82001
Library of Natrona County
307 East Second
Casper, Wyoming 82601
Lincoln County Library
Courthouse
Kemmerer, Wyoming 83101

Rock Springs Public Library
400 "C"Street
Rock Springs, Wyoming 82901
Saratoga Public Library
104 West Elm
Saratoga, Wyoming 82331
Sweetwater County Library
177 N. Center
Green River, Wyoming 82935
University of Wyoming Library
University Station
Box 3334
Laramie, Wyoming 82070
Western Wyoming Community College Library
Rock Springs, Wyoming 82901
Wyoming State Library
Government Publications
Supreme Court & State Library Building
Cheyenne, Wyoming 82002

Wyoming Game and Fish Department

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Wyoming, State of

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Wyoming Taxpayer's Association 1977. Wyoming property tax rates. Cheyenne, Wyoming. (August)

Wyoming Travel Commission, Cheyenne, Wyoming.
a. Wyoming 1976 official highway map.
b. Afoot, backpacking, and climbing.
c. Camping.
d. Southern big Wyoming.
e. Dude ranches, lodges and resorts.
f. Wyoming state parks, historic sites and trails.
g. Wyoming roadside rest areas.
h. Family water sports.
i. Serendipity in the snow.
j. Various brochures published by the Commission.

Wyoming Game and Fish Department
1975. A strategic plan for the comprehensive management of wildlife in Wyoming 1975-1980. Vol. 1.
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1977b. Current status and inventory of wildlife in Wyoming. Wyoming Game and Fish Dept. Cheyenne.
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g. Wyoming roadside rest areas.
h. Family water sports.
i. Serendipity in the snow.
j. Various brochures published by the Commission.

Telephone Contacts by Centaur Management Consultants, Inc.
(Socioeconomics Section)

DeHerrera, Abe 1978. Police Chief, Rawlins, Wyoming.

Grunkemeyer, Gary 1978. City Manager, Cheyenne, Wyoming.

Hawes, Douglas 1978. Chairman, Environmental Commission, University of Wyoming, Laramie, Wyoming.

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CHEROKEE
proposed project

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

BACKGROUND

In November 1976, the Pacific Power and Light Company (PP&L) submitted a mining and reclamation plan for the proposed Cherokee surface mining project to the Office of the Area Mining Supervisor, Geological Survey (GS), Denver, Colorado, describing a projected 40 year mine. The mining and reclamation plan was filed under Federal Regulation 30 CFR 211 (May 1976) and was accepted by GS for review.

The mining and reclamation plan included in this statement was submitted for review prior to promulgation of the initial regulations (30 CFR 700) required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87) and has not been officially reviewed for compliance therewith. Therefore, the applicant's plan may not fully reflect the requirements of the initial regulations. However, in this statement the initial regulations are considered as required federal mitigating measures the same as all other applicable regulations.

The mining and reclamation plan will be returned to the operator for revision in accordance with the applicable initial regulations. As soon as the applicant's plan is revised and returned to GS it will be evaluated with the Office of Surface Mining to determine compliance with the requirements of Federal Regulations 30 CFR 211 and 30 CFR 700. The mining and reclamation plan cannot be approved until it conforms to all applicable federal requirements.

The proposed Cherokee project area lies within the checkerboard land ownership pattern and contains 10,671 acres: 4,071 federally owned; 640 state owned; and 5,960 privately owned (surface ownership) (see Figure CH1-1 and Map CH11). The federal acreages are under existing federal coal leases W-092140, W-092141, W-0313559, and W-0312917. The state and private coal acreages within the project area are also under lease.

The mining and reclamation plan and supporting data submitted by PP&L are on file at the Office of the Area Mining Supervisor, GS, Conservation Division, Denver, Colorado; and at the District Office, Bureau of Land Management (BLM), Rawlins, Wyoming, and can be reviewed by the public at those locations.

PROPOSED ACTION

The action before the federal government is to consider for approval the mining and reclamation plan and the issuance of rights-of-way for construction of ancillary facilities and relocation of some existing facilities (highway, power lines, telephone line—see Table CH1-1).

Purpose and Objective

The purpose of the proposed action is to allow mining of 250 million tons of coal at a rate of about 6 million tons per year (see Figure CH1-2).

The objective is to help meet the national energy demands over the proposed 40-year life of the mine. The specific markets for the coal are unknown; however, it is projected that the coal would be delivered to Midwest markets.

Location

The proposed mine would be located about 30 miles west-southwest of Rawlins, Wyoming (see Figure CH1-1 and Map CH1-1).

The proposed surface facilities would be constructed on public land in Section 12, and on private land in Section 13, T. 19 N., R. 91 W., 6th P.M. (see Map CH1-2). Surface and coal ownership is listed in Table CH1-2 and shown on Map CH1-3.

Predisturbance Inventories and Analyses

Specific inventories were conducted under the direction and/or cooperation of the Pacific Power and Light Company in consultation with the BLM concerning threatened and endangered plants and animals, raptor nesting sites, archeological sites, historical sites, and paleontological localities.

An inventory was conducted by the BLM of the proposed Cherokee project area for proposed endangered and/or threatened plant species. The inventory did not reveal the presence of any plants listed on the current (1977) list of proposed endangered and/or threatened species.

The Wyoming State Game and Fish Commission conducted an inventory, funded by BLM, of raptor nesting sites on and adjacent to the proposed project area. No nests (active or inactive) were found in areas which would be physically disturbed by the mining operations.

Table CH1-1

RIGHTS-OF-WAY REQUIRED FOR CHEROKEE MINE

Applicant	Facility	Application Number	Miles* Total	Miles* Federal	Width (feet)	Acres** Total	Acres** Public	Location of public land involved
	Access Road	None Yet	1.0	0.3	100	12.6	3.2	Section 26, T.20N., R.92 W.
	Haul Road	None Yet	0.6	0.6	100	7.8	7.8	Section 26, T.19N., R.92W.
	Rail Spur	None Yet	6.2	2.9	200	150	69	Sections 8, 20, 30, T.20N., R.91W. Sections 2, 12, T.19N., R.91W.
	Power Line (115-kv)	None Yet	33.4	15.4	100	405	187	Sections 12,14,22,28, T.20N., R.91W.
	Telephone Line - within access road ROW	None Yet						
	Water Pipeline	None Yet	3.4	2.8	50	20.8	16.8	Section 12, T.19N., R.92W. Section 6, T.19N., R.91W. Section 32, T.20N., R.91W.
	Relocation - Highway 789	None Yet	6.7	2.9	200	163	69	Section 34, T.20N., R.92W. Sections 4, 16, T.19N., R.92W.
	Relocations - 230-kv Power Line	None Yet	8.5	3.2	150	154	59	Sections 28,20, T.20N., R.91W. Sections 24, 26, 34, T.20N., R.92W.
	19.8-kv Power Line	None Yet	6.9	2.7	50	42	16	Section 34, T.20N., R.92W. Sections 4,16, T.19N., R.92W.
	Relocation - Telephone Line	None Yet	2	1	16	4	2	Sections 4, 16, T.19N., R.92W.

*Only off-site portions would require rights-of-way

**Rights-of-way acreages will differ from disturbed acreages for the same facility, since the ROW figures are what would be covered by the permit, not what would actually be used.

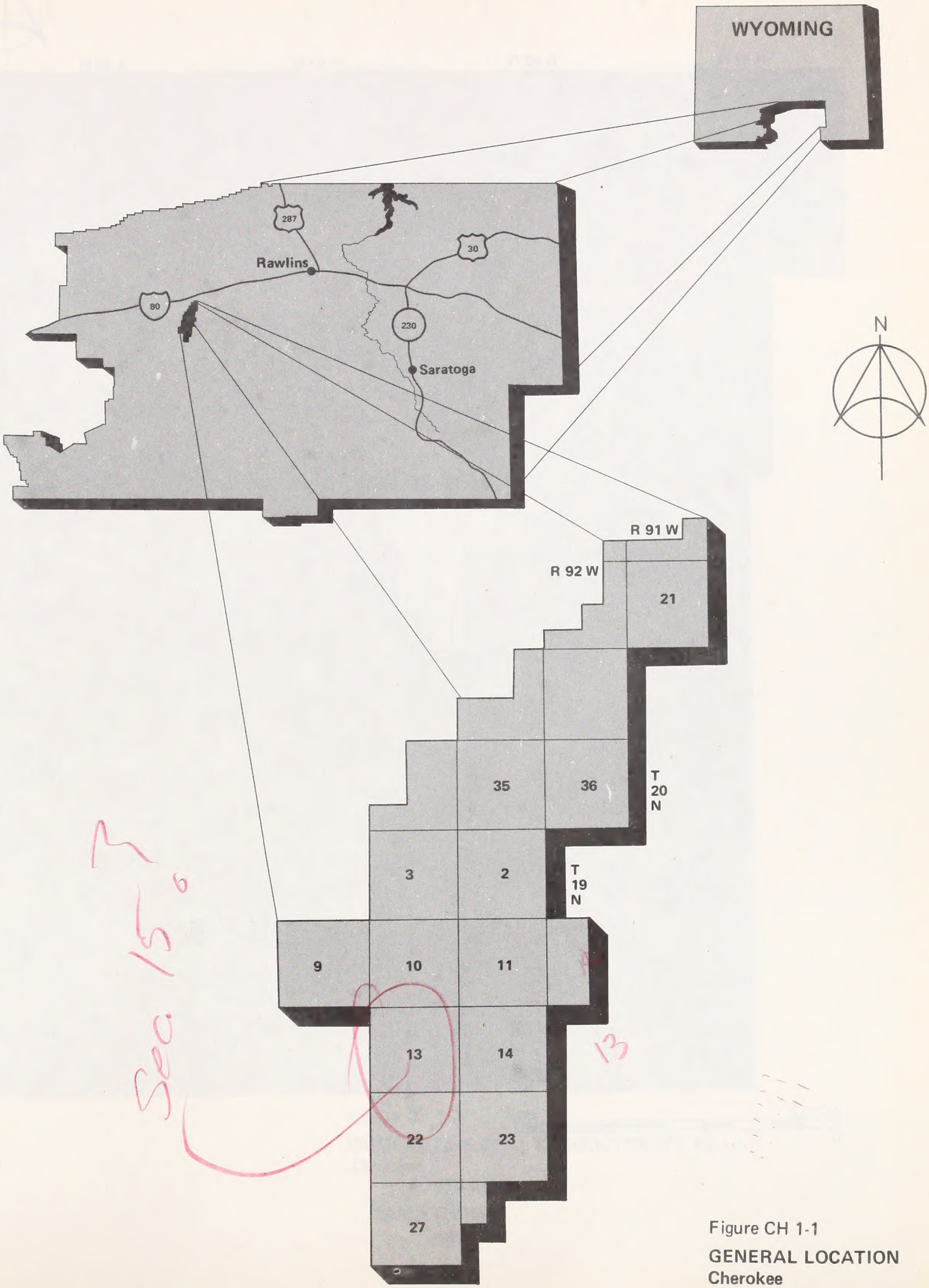
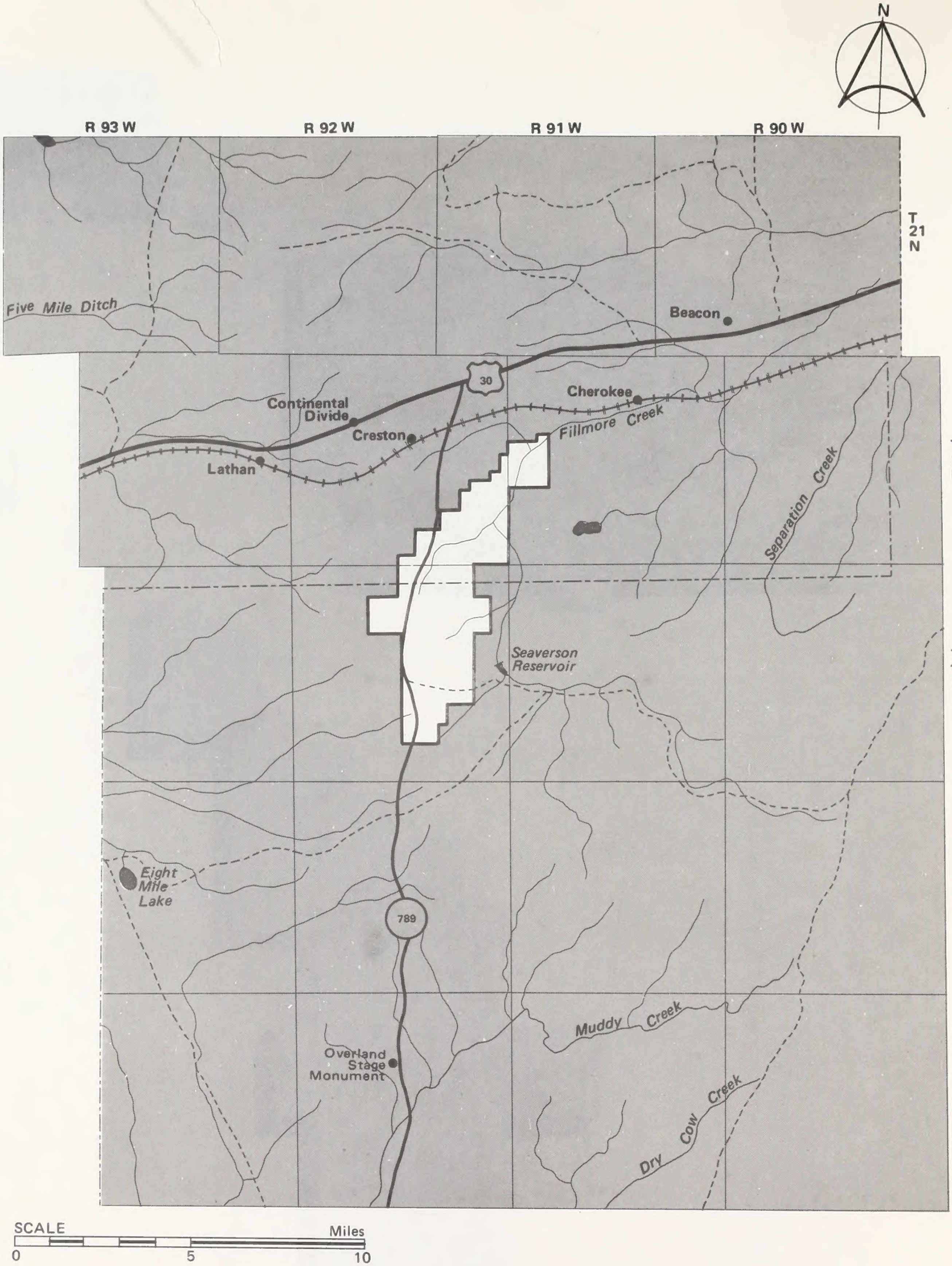


Figure CH 1-1
GENERAL LOCATION
Cherokee



Map CH 1-1

VICINITY MAP
Cherokee

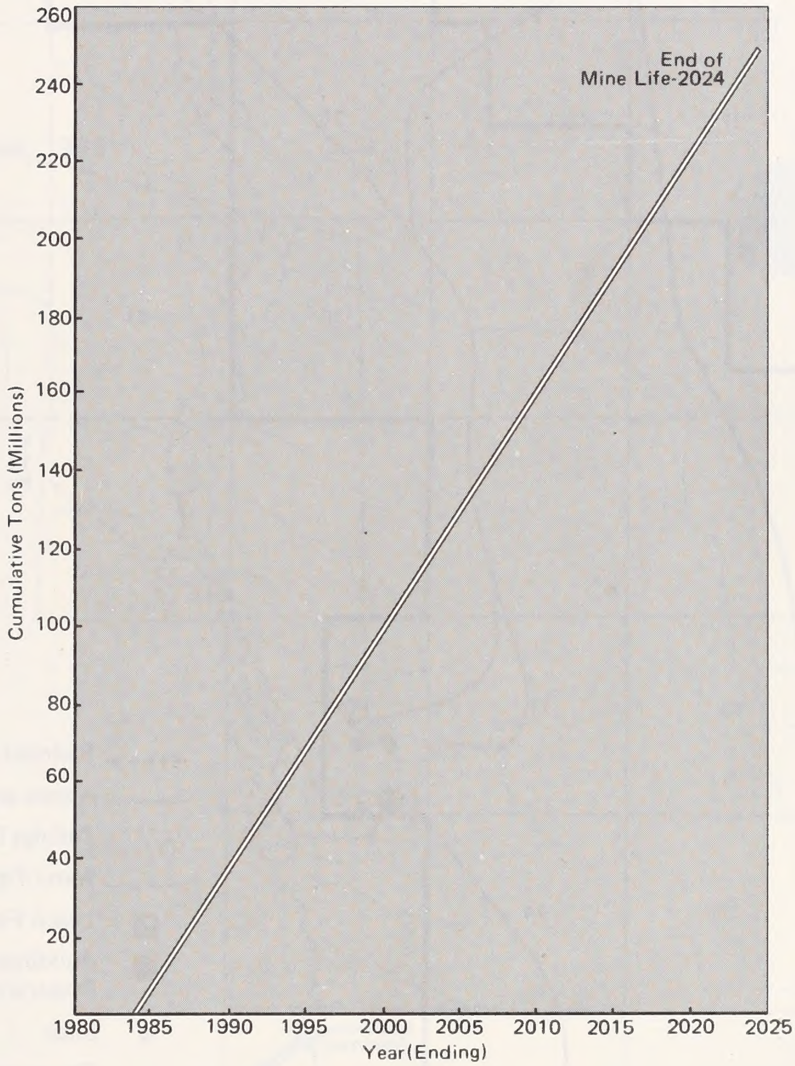
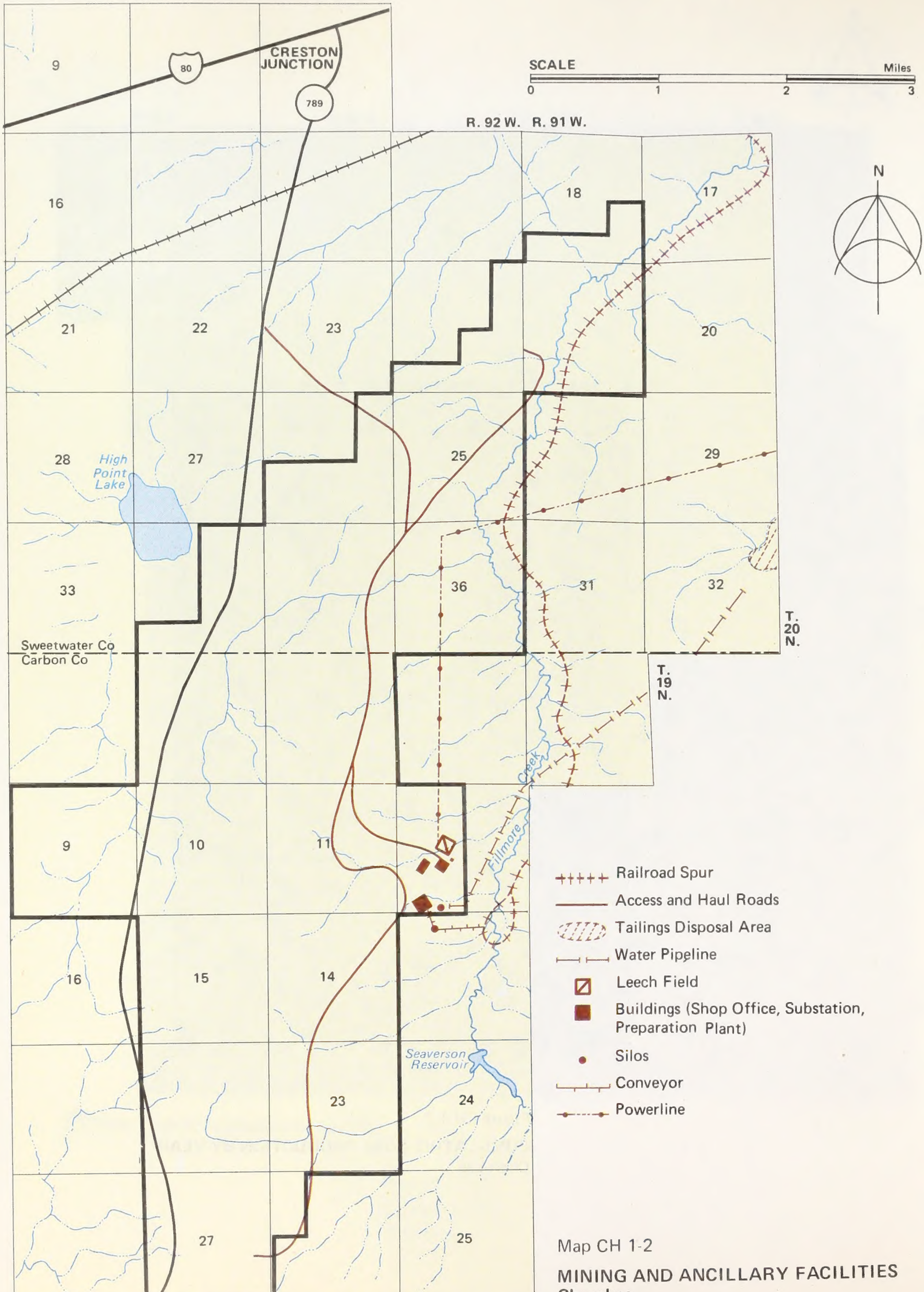


Figure CH 1-2

CUMULATIVE COAL PRODUCTION BY YEAR
Cherokee



Map CH 1-2

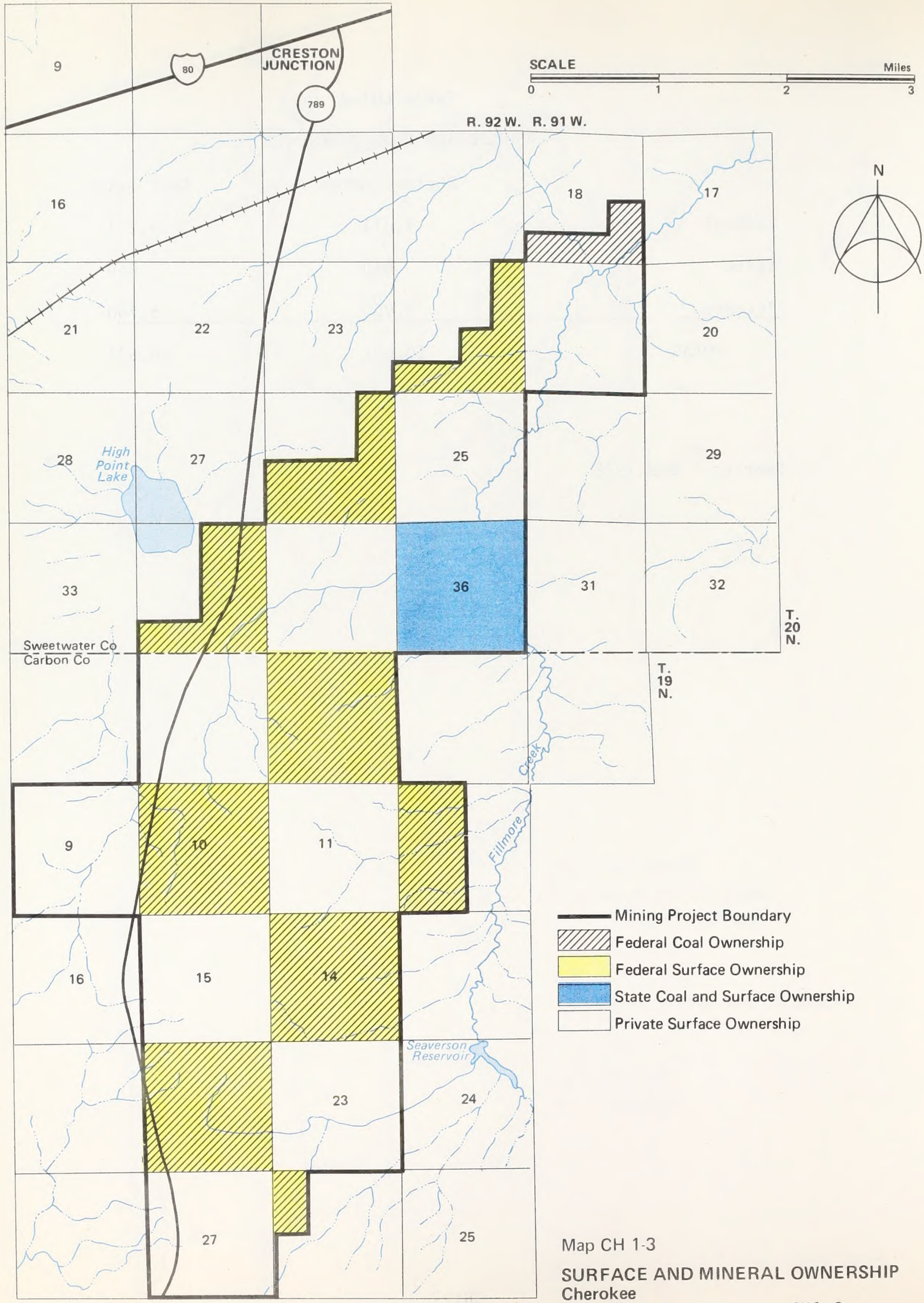
MINING AND ANCILLARY FACILITIES
Cherokee

Table CH1-2

SURFACE AND COAL OWNERSHIP

	Surface Acres	Coal Acres
Federal	4,071	4,271
State	640	640
Private	5,960	5,760
TOTAL	10,671	10,671

Source: BLM 1978



Map CH 1-3

SURFACE AND MINERAL OWNERSHIP
Cherokee

No prairie dog towns exist within the project boundaries; therefore, no inventories for black-footed ferrets are planned.

The State Historic Preservation Officer was consulted concerning any National Register sites within the project area.

A cultural resource inventory was conducted on the project area during 1976 by the University of Wyoming. Section 106 documentation will be initiated for any sites determined to be of National Register quality.

An Order III soil survey was conducted on the project area by the Soil Conservation Service. In accordance with the mining and reclamation plan, analyses of the overburden will be made for physical and chemical properties.

The results of all the surveys may be found in Chapter 2.

Mine and Related Facilities

The company proposes to open the Cherokee Mine as a conventional draglinestripping operation. Construction would begin in 1982 with 200 construction workers. Coal mining would begin in 1984 and would require 285 people once full production was reached.

The planned facilities fall roughly into three categories: those associated with the mining operation, those associated with coal processing and storage, and those associated with support developments.

Mining Operation

Office and Shops. The mine office and shop complex would be constructed at the mine end of the mine access road near the loop track. The major structures would be an office, shop, and warehouse building; changehouses; and an electrical equipment shop and storage building. A fuel oil storage tank, gasoline storage tank, and facilities associated with fuel loading and dispensing would also be constructed at the site. Dikes to contain more than the total volume of the tanks (110%) would be constructed around the storage tanks. Parking, outside storage areas, and miscellaneous storage structures complete the office-shop complex. Explosive storage would be separate from the office-shop complex and built to applicable standards.

Mining Equipment. Many of the larger items of mining equipment for this proposed mine would require on-site assembly prior to commencing operation. Of particular importance are the draglines which would require special preparation of a site for erection. The erection site for major mining equipment would be in the vicinity of the rail loop. Other pieces of equipment would be assembled in the shop area.

Coal Processing and Storage

Coal Handling Equipment. The coal handling equipment would include a truck dump hopper, preparation plant structure, and storage piles. The dump hopper would receive coal from off-highway, bottom-dump trucks and provide surge protection. The preparation plant would house a 1,500 ton per hour primary crusher and one 235 ton per hour secondary crusher, as well as a refuse hopper. The coal would be crushed to 6 inches or smaller in a single operation, then conveyed to a raw coal stockpile or to the washing facility. The coal would be washed in a typical Baum jig washer. The washing facility would consist of a primary wash box with complementing secondary or middlings compartments, dewatering and sizing systems, conveyance systems, water reclaiming circuitry, fine coal recovery systems, storage facilities, and storage reclaim and load-out facilities.

The crushed raw coal would feed into the primary wash boxes at a rate of 1,500 tons per hour. In the first cleaning, the wash box rejects would be transferred to the refuse hopper for later disposal in the mined-out pit. The secondary or middlings sections of the washer would provide for secondary crushing and reintroduction of this crushed product back to the primary wash box for further separation of coal and refuse. The final cleaned products, amounting to 83% of the raw product, would be dewatered by screens and centrifugal dryers, depending upon the size of the product, and deposited in storage facilities to await loading to unit trains. The wastes would amount to 17% of the raw product and would be discharged at a rate of 260 tons per hour. Water would be used at a rate of 367 gallons per minute (gpm), of which 176 gpm would be discharged with the wet coal and 183 gpm would be discharged with the refuse to the mine pit. An undetermined amount of refuse water would be decanted and recirculated through the washing plant. No wash water would be discharged off the site.

Support Developments

Support developments include an access road, railroad spur, power line, telephone line, and water facilities. See Table CH1-1 for rights-of-way required.

Roads. The surface facilities would be connected to Highway 789 with a single access road 4.7 miles long, built to county specifications and in conformance with Federal Regulations 30 CFR 715.17(1). The natural drainage along this road would be controlled by metal culverts where needed; other appropriate erosion control structures would be constructed as needed. All mine roads, other than the main access road, constructed by the mine operator would be considered private and would be used only by employees or other authorized persons. The public would be excluded for reasons of safety. The main access road would disturb 49 acres; 17 public, and 32 state and private lands.

Secondary haul roads would be constructed from the main haul road to active pits as needed. Service roads would connect the main haul road with the area behind the highwall to give access to draglines and drills and would move as the highwall advances. Haul roads would

be 100 feet wide. Haul and service roads would be constructed of gravel or clinker found at or near the mine. Haul roads would disturb 137 acres: 59 public, and 78 state and private.

The development of the mine would necessitate the relocation of State Highway 789. The relocation route would be approximately 6.7 miles long, located approximately 1 mile west of the present highway location at the widest diversion point. This highway relocation would require 163 acres; 69 public and 94 private.

Railroad Spur. A 7.7-mile railroad spur would be constructed by the Union Pacific Railroad Company. The rail spur would begin at the Union Pacific Railroad track in Section 8, T. 20 N., R.91 W., and terminate in a loop track in Sections 12 and 13, T. 19 N., R. 92 W. This railroad spur and loop would disturb 101 acres; 35 public, 66 state and private.

Power Lines. A 115-kv power line would be built along the existing 230-kv line right-of-way from a point near Sinclair and extended southward into the surface facility area. Internal power distribution lines would be constructed, moved, and removed as mining progresses. The major consumers of power would be the electric draglines, overburden drills, and the preparation plant. There would be a relocation of the 230-kv power line at the north end of the property. Also, there would be a relocation of a 19.8-kv power line along the relocation route of State Highway 789. All mine-related power lines would be constructed in accordance with standards established in the U.S. Department of Agriculture's bulletin, REA Bulletin 61-10, to reduce accidental electrocution of raptors.

Telephone Line. Mountain Bell would extend telephone service to the mine by constructing a 7.7-mile wood pole line parallel to the railroad spur. A short-wave radio base station would be constructed at the office building to facilitate communication in and around the mining area.

Water Facilities and Sewage Treatment. Water for the coal wash plant and for domestic use (potable) would be supplied at a rate of 400 gpm from wells in excess of 3,000 feet deep. A water storage tank and water treatment system, if required, would provide potable water. Another storage tank would provide water for dust control systems at the coal transfer points and for sprinkling haul roads.

A water pipeline would be built from the coal processing facilities to a settling area (a dry playa lake bed) off the project area. A return pipeline would be built so that the decanted water could be reused in the plant. Total length of the pipeline would be 3.4 miles. An alternate plan would be to dewater the fine reject in the plant and bury the waste in the mined out areas of the pit.

Sewage would be treated in a septic system or waste lagoon approved by the state of Wyoming. Water for fire protection and fire control would be stored in tanks. The acreage required for these facilities is included within surface facilities.

Proposed Mine Layout and Mining Sequence

The Cherokee Mine would be oriented generally north-south. It would be mined in blocks over a period of about 40 years as shown on Map CH1-4.

In general, the mining sequence would follow the Upper and Lower Cherokee seam outcrops, with successive north-south pits progressing from the east coal outcrop westward to the mining limits.

Overburden removal would begin with a box cut along the Lower Cherokee outcrop, in a typical dragline operation as illustrated in Figure CH1-3. Overburden from this first cut would be spoiled beyond the outcrop. Pits would advance southward along the Lower Cherokee outcrop until the Upper Cherokee outcrop is reached (see Figure CH1-4). The pits would then advance northward along the Lower Cherokee outcrop. Finally, the pits would be worked over the entire length, or in segments as coal quality dictates.

In approximately the third year, a second dragline would begin operating on a new box cut extending from the south end of the first dragline box cut northwest across the field, along the Upper Cherokee outcrop. The dragline would remove the Upper Cherokee overburden and the coal would be mined by a truck-shovel operation. The interburden between the Upper and Lower Cherokee seams would then be removed by the same dragline on a second pass. These seams eventually converge.

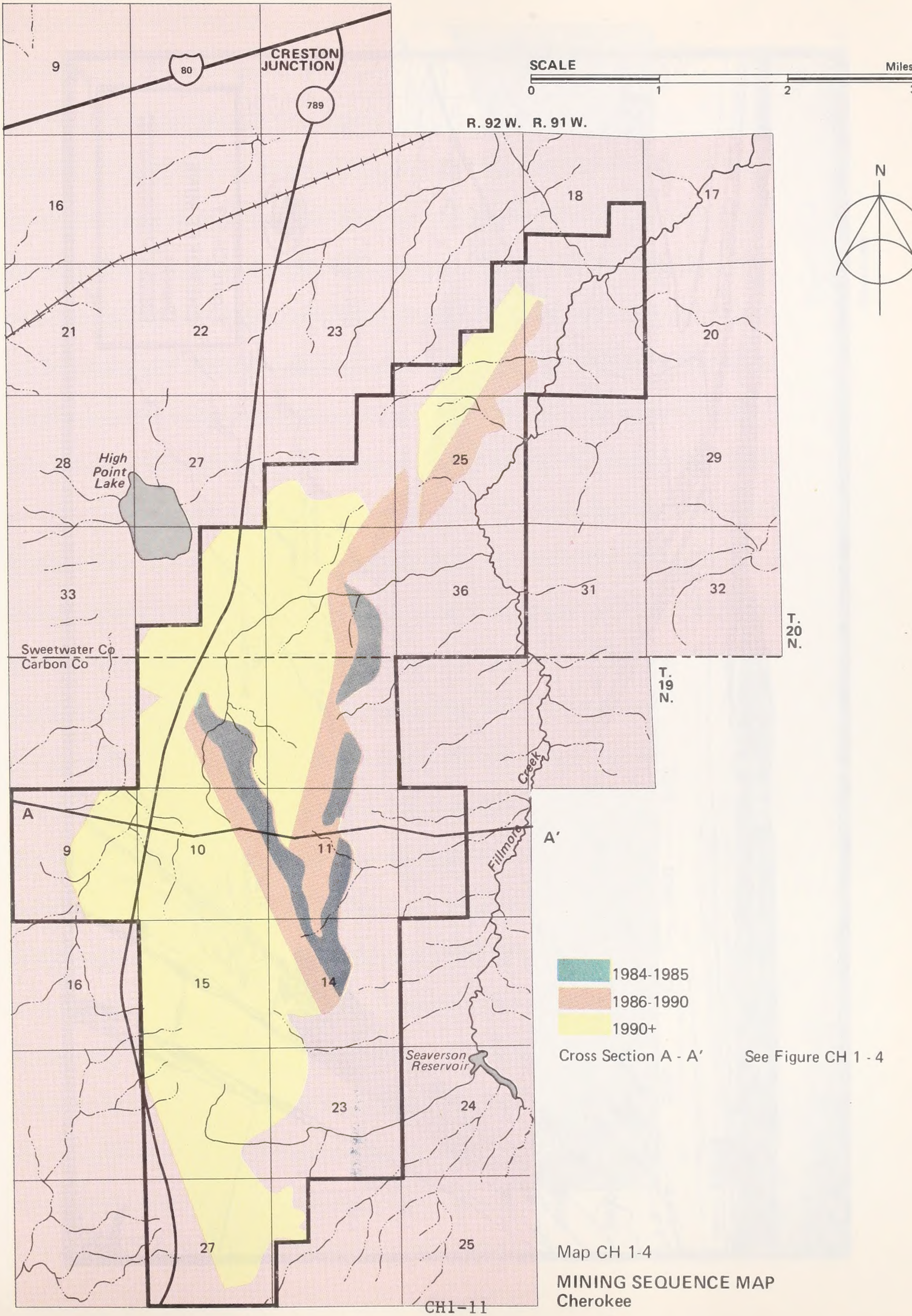
Both draglines would continue in this manner throughout the mine life, with one mining diagonally across the field in the converged seams and the other mining southward, initially in the Lower Cherokee seam and later in both the Upper and Lower seams. The acreages to be disturbed by years after the mine opens are listed in Table CH1-3.

Mining and Reclamation Operations

Topsoil Removal and Deposition

Soil surveys in progress would determine the major soil types in the mining area, their suitability for use in revegetation, and the desirable removal depth.

Prior to disturbing an area, these soils would be removed by scrapers or trucks to a specified depth as determined by the survey and stockpiled in one of the five stockpiles for later use (see Map CH1-5). They might also be applied directly on a recontoured reclamation area. The stockpiled material would be protected from wind and water erosion, if necessary, by planting with a temporary vegetation cover or other best management practices. Topsoil handling will be done in conformance with Federal Regulation 30 CFR 715.16.



Map CH 1-4

MINING SEQUENCE MAP
Cherokee

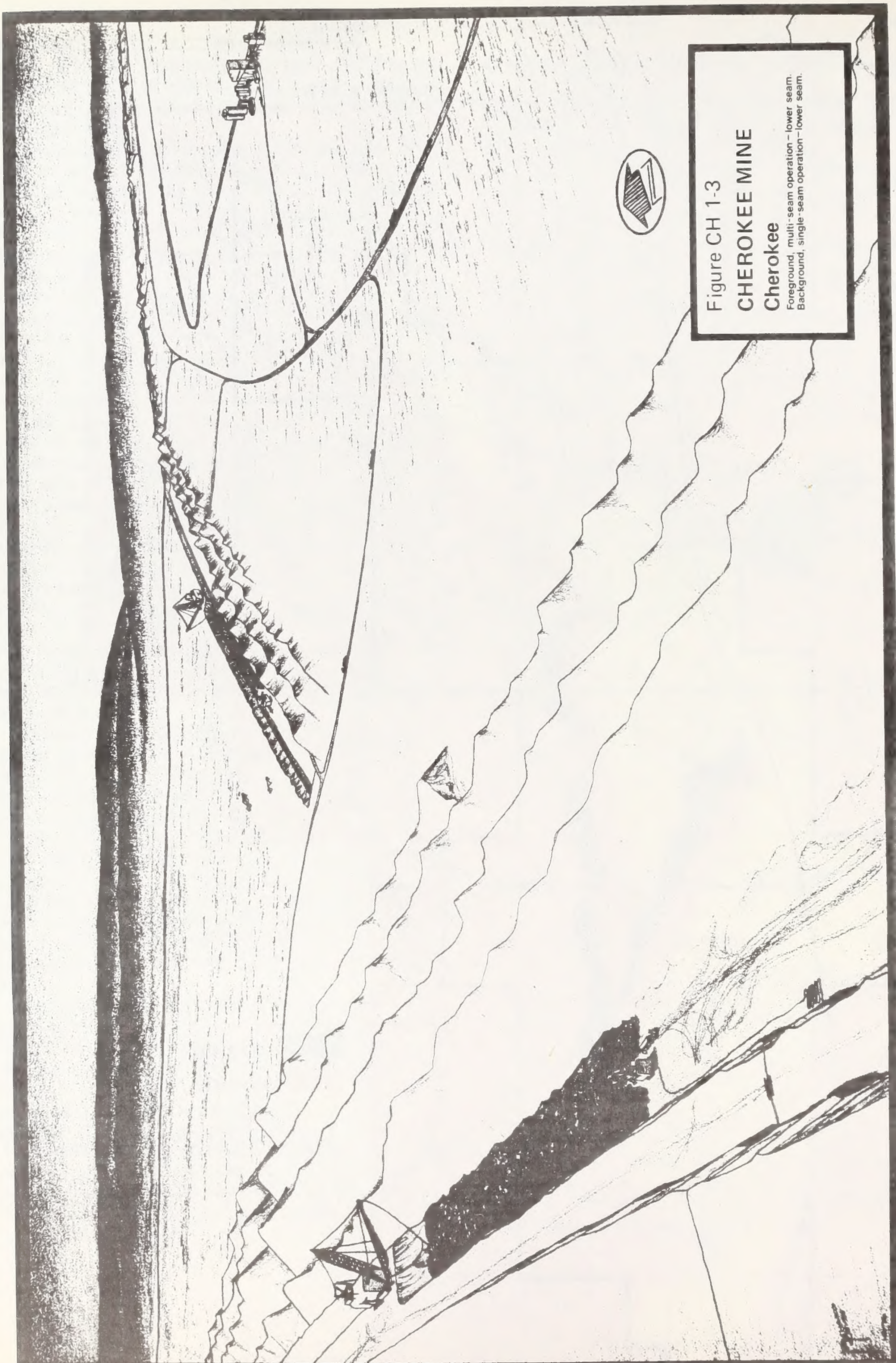


Figure CH 1-3
CHEROKEE MINE
Cherokee
Foreground, multi-seam operation—lower seam.
Background, single-seam operation—lower seam.

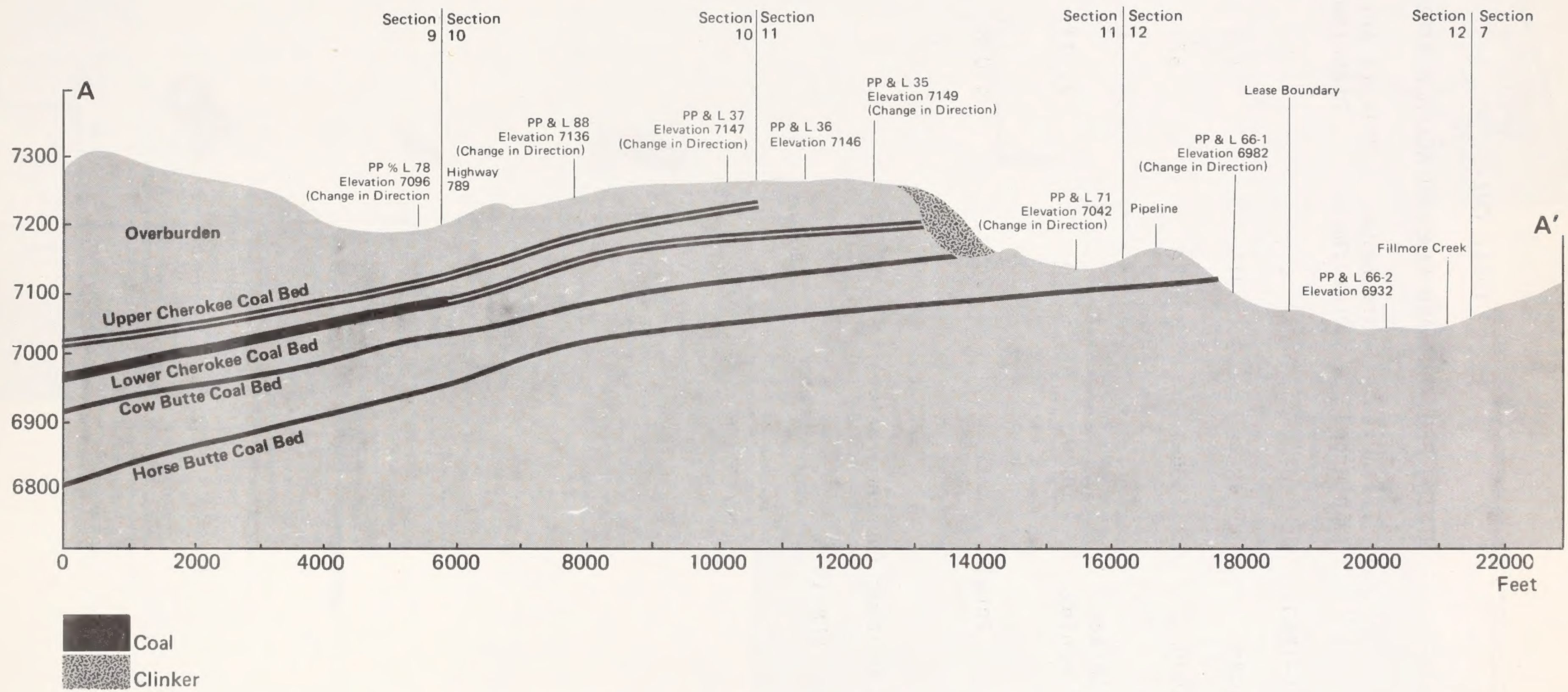


Figure CH 1-4

COAL SEAM CROSS SECTION A-A′
Cherokee

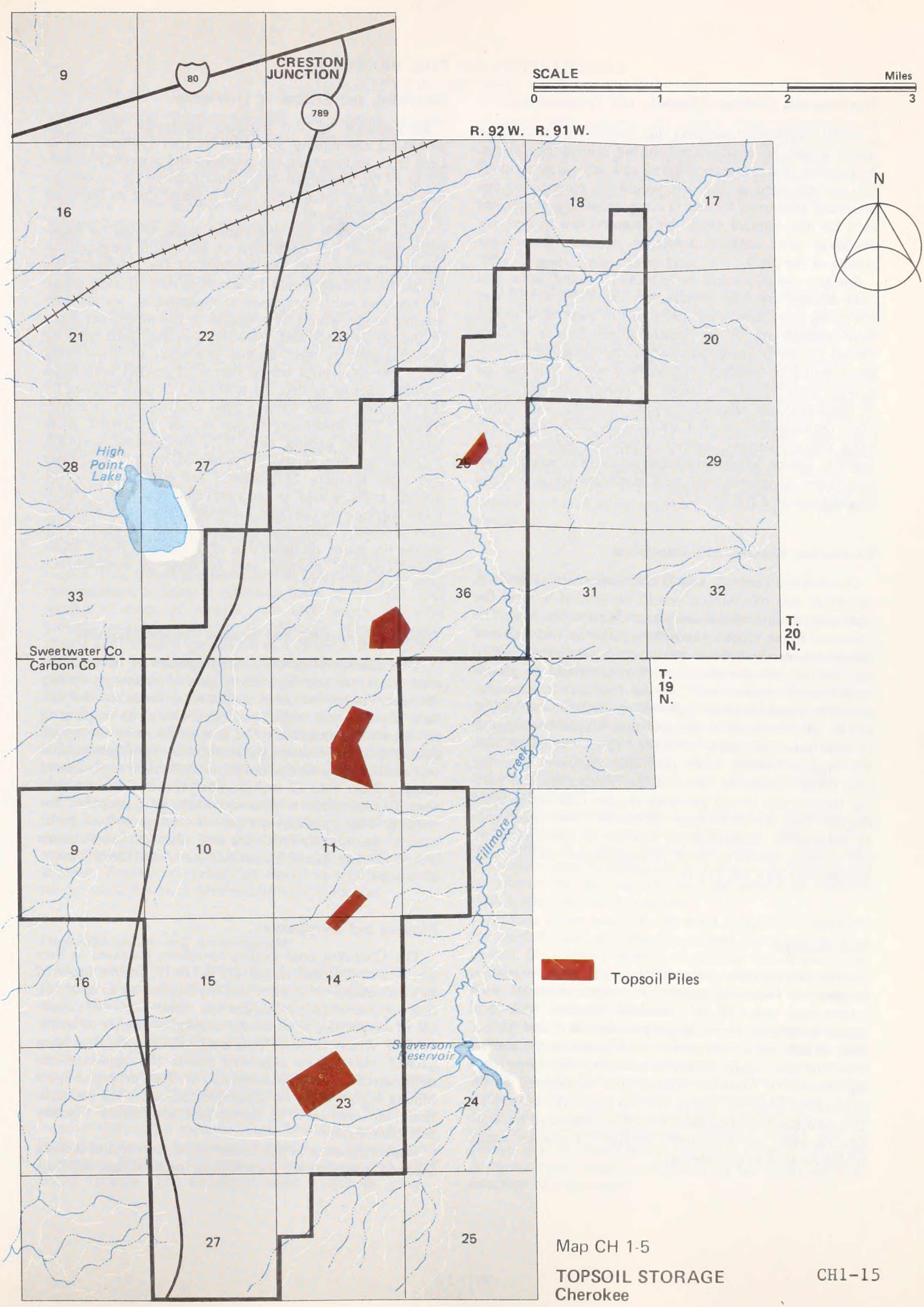
Table CH1-3

MINING SEQUENCE AND PLANNED ACREAGE DISTURBED BY YEARS*

Year	Public Acres Disturbed	State Acres Disturbed	Private Acres Disturbed	Total
Present-1980	0	0	0	0
1981-1985	485	214	432	1,131
1986-1990	436	28	873	1,337
1990+ to end of mining	2,382	0	2,773	5,155
Total	3,303	242	4,078	7,623

*Final Contour (noncumulative)

Source: BLM 1978



Map CH 1-5

TOPSOIL STORAGE
Cherokee

Watercourses, Drainage Channels, and Impoundments

Initial information suggests that little if any, subsurface water would be encountered during mining operations. Any water that was encountered and any surface runoff that accumulated in the pits would be pumped to impounding structures for use in road sprinkling. Water not used for dust control would be decanted and treated, for discharge into surface drainages or into the closed system of the plant.

Surface runoff would be diverted around mine and coal storage areas as required by 30 CFR 715.17 and Wyoming state law. Few parts of the mine area would have enough runoff to require more than a shallow bladed furrow of temporary nature. No permanent diversions would be needed. Any surface water that left the project area would be treated to reduce concentrations of dissolved and suspended solids to levels that would meet requirements of 30 CFR 700.15, EPA, and Wyoming DEQ. Adequate culverts would be installed under roads to ensure unrestricted flow of surface waters. Surface water diversions will meet standards set in Federal Regulations 30 CFR 715.17(a).

Overburden Removal and Disposition

Overburden removal would commence with a box cut operation and overburden would be spoiled beyond the coal outcrop into mined-out areas. Overburden would be removed by an electric dragline parallel to the strike of the coal beds. Successive cuts would parallel the initial cut. As the pits advanced, overburden would be placed in previously mined cuts. On the final cut, overburden could be placed on the highwall to facilitate backfilling of the pit. Overburden disposal sites would be designed to meet standards set in 30 CFR 715.15. On initial cuts, the dragline would work from the highwall over the coal being uncovered. Most of the overburden and parting interburden would probably require blasting to some degree. This would be done in vertical blast holes with an ammonium nitrate-fuel oil mixture or the equivalent. All blasting would be done in accordance with Federal Regulations 30 CFR 715.19.

Coal Removal

After overburden removal, the coal seam would be cleaned of remaining loose overburden material with rubber-tired tractors or front-end loaders. The coal would be drilled with a single pass coal drill and blasted with an ammonium nitrate-fuel oil mixture or the equivalent. The coal seams would be mined by two large loading shovels or front-end loaders and transported to the preparation plant by 120 or 150 ton capacity haul trucks. The two loading operations would be separated to facilitate blending of the mined product. Entrance ramps would be kept to a minimum.

Backfilling and Grading of Overburden

Reclamation of the material generated by mining would lag the mining operation by two to three cuts to keep from endangering the workers and prevent redisturbance of the reclaimed area. Final grading upon completion of mining would take 1 to 2 years, due to highwall and ramp reductions.

Final highwalls and the mined areas would be backfilled, graded, and contoured to the extent necessary to essentially reestablish the contour of the original landforms. Backfilling would be accomplished by sidecasting of material with draglines. Supplemental wastes and washer refuse would be returned to the mined-out areas of the pit by truck and would be covered with spoil by the draglines in their normal operation of uncovering coal. The spoil piles would be rough graded with large crawler tractors so that the peaks and troughs created by the dragline would form a final contour that is gently rolling. The maximum slopes in the reclaimed areas would not be greater than 3.5:1 (horizontal: vertical). Finished grading would be achieved by motor graders and some scrapers. Stabilization and compaction of the graded areas would be accomplished by heavy equipment working on the spoil material during early reclamation processes. Drainage patterns would be restored to assure no major rechanneling of water to off-site areas. Backfilling and grading will be done in conformance with 30 CFR 715.14.

Topsoil Replacement and Erosion Control Measures

After the spoil has been rough graded to the approximate final contour and finish graded with appropriate terraces, ditches or other stabilization methods, the surface, if necessary, would be ripped along the contour to enhance water retention. The previously removed topsoil would then be returned by scrapers to these graded and prepared areas with the depth of the topsoil replacement ranging from 8 to 12 inches. The topsoiled areas would then be regraded, where necessary, and prepared for seeding. The types and amounts of seeding as well as the need to incorporate fertilizers and other soil amendments would be determined by further studies of the soil characteristics.

Planting and Revegetation

The Cherokee coal mining operation, pursuant to Section 515 of SMCRA and 30 CFR 715.13, will be required as a minimum, to restore the lands affected to a condition capable of supporting the use which they were capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. A mining permit will not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the reclamation plan contained in the permit application (Section 510, SMCRA).

Implementation of the reclamation plan would include seedbed preparation, establishing seed mixes, seeding,

and evaluation. Topsoil handling and seedbed preparation will be done in conformance with 30 CFR 715.16 and 715.20.

It is anticipated that surface manipulation to create small watersheds that prevent runoff would be an important part of the seedbed preparation. The methodology of manipulation or the size of catch basins has not yet been determined, but it is anticipated that each basin would be between 5 and 25 square feet in area. Such surface manipulation would take place after topsoil has been applied.

Seed mixes would include native vegetation to the extent possible, and would be designed to obtain a satisfactory balance of grasses, shrubs, and forbs. The seed mixture would utilize locally grown genotypical seed and seedlings when possible. The seed mix would be of a pure and viable nature and seeding rate would be on a pure live seed basis. Grasses may include western wheatgrass, thickspike wheatgrass, Indian ricegrass, needleandthread, or sand dropseed. Forbs such as yellow sweetclover may be planted. Shrubs may include fourwing saltbush, winterfat, or Nuttal saltbush. The seed mix would include species which do well at differing seasons of the year, to ensure adequate vegetative production throughout the growing season.

Seeding would be done by broadcast and drilling techniques. This would enable maximum utilization of surface manipulation, seeding at optimum times of the year, and mixing of seeds of various sizes and shapes. All drill seeding would be done on the contour. When grasses, shrubs and/or forbs are seeded as a mixture, they may be drill seeded in separate rows at intervals specified in the planting guidelines of the Soil Conservation Service. Such mixed seeding would be done in this manner whenever found to be necessary to avoid competition of vegetal types or to avoid seed distribution problems due to seed sizes. Mulching with straw or hay following seeding would be used if shown to be of value. Supplemental irrigation is not planned.

Evaluating reclamation success would involve sampling landforms, soil characteristics, and vegetative characteristics. Landform and soil characteristic evaluations would take place upon completion of regrading and seeding. Vegetative evaluations would be continued until revegetation has been determined to be a success.

Decommissioning and Abandonment

On completion of mining, final abandonment of the property would begin. This would include the removal of all facilities except those deemed necessary or desirable for subsequent uses, subject to the approval of the area mining supervisor and affected surface owners. Areas disturbed in construction of support facilities would be temporarily reclaimed; however, final reclamation could not be completed until the mining is complete and the facilities were no longer needed. The facilities to be removed would include roads, buildings and storage facilities, power lines, communications equipment, coal processing facilities, rail spur and loop track, and other utility systems. The reclaimed areas would be graded, covered with topsoil, and seeded. Final reclamation efforts and associated activities should be completed within the mined area in a 3 to 4 year period after final mining is completed. Reclamation of all ancillary facilities should be completed within 5 years after mining completion (see Table CH1-4).

Present and Future Land Use

The current use of the project area is primarily grazing and wildlife forage. Carrying capacity for grazing is closely tied to vegetative productivity, particularly to those species with high forage value. Wildlife use is associated with both food availability and cover. Cover involves vegetation and landforms; important vegetative cover includes shrubs and grasses. Based upon these aspects, the proposed future uses of the reclaimed lands (as recommended in the BLM Overland Land Use Plan) would be domestic livestock grazing and wildlife habitat. The standard for determining if adequate grazing has been restored for the support of domestic livestock would be based upon vegetative cover and forage productivity.

Pollution Control Methods

Dust from mining operations and haul roads would be contained by watering techniques.

If material creating a fire hazard were uncovered during or as a result of the mining process, it would be removed, covered, or buried. Wastes would be stabilized by constructing waste piles in compacted layers witn the use of incombustible and impervious materials. Waste containing coal would be stored separately. Culverts or bridges would be installed where necessary to allow access by the surface owner and the operator for fire control purposes.

Coal storage areas would be designed to eliminate fire hazards due to spontaneous combustion or other accidental ignition. If a fire occurred, the operator would take immediate steps to extinguish it. When a pit is completed or abandoned, the face of the coal would be covered with a noncombustible material.

Surface water would be diverted around the operation for the following purposes: to control water pollution, to control unnecessary erosion, to protect the on-going operation, and to protect the water rights of downstream users. A surface water monitoring plan will be designed in conformance with 30 CFR 715.17(b).

Temporary diversion ditches would be built to engineering standards. The bottoms would be seeded with approved grasses where appropriate. Culverts or bridges would be installed where necessary. Diversion ditches would not discharge directly upon topsoil storage areas, spoil piles, or other unconsolidated material. Spoil, topsoil, or other unconsolidated material would not be pushed into or placed below the flood level of a flowing or intermittent stream, except during the approved construction of a diversion.

Table CH1-4

TOTAL CUMULATIVE DISTURBED AND RECLAIMED ACRES*
CHEROKEE

Year	Public Acres Disturbed	Public Acres Reclaimed	State Acres Disturbed	State Acres Reclaimed	Private Acres Disturbed	Private Acres Reclaimed
1981-1985	863	2	226	0	685	3
1986-1990	1,375	335	254	7	1,662	444
1990+	3,757	3,673	254	254	4,435	4,318

*Reclaimed Acres--involves time for backfilling, grading, contouring, topsoil replacement, and initial seeding.

Source: BLM 1978

All wet refuse from the coal working process would be pumped to a retention area for settling. The water would be decanted for reuse in the plant.

Any materials toxic to plant growth would be buried at a sufficient depth to prevent topsoil contamination (a minimum of 4 feet).

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposed action. A more complete description of the authorizations is provided in Chapter 1 of the Regional Analysis.

Assistant Secretary of Energy and Minerals

The Assistant Secretary shall approve the mining permit application and significant modifications or amendments thereto prior to commencement of mining operations by the company. The permit application includes the proposed mining and reclamation plan.

Office of Surface Mining (OSM)

OSM, with concurrence of the surface managing agency (BLM) and GS, recommends approval or disapproval of a mining and reclamation plan to the Assistant Secretary, of Energy and Minerals. Whenever a state has entered into a state-federal cooperative agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and department authorized to take final actions on the permit.

Bureau of Land Management (BLM)

The BLM developes the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources other than coal and the post-mining land use of the affected lands.

Geological Survey (GS)

GS is responsible for development, production, and coal resource recovery requirements included in the mining permit.

State and County

Wyoming Department of Environmental Quality (DEQ)

Whenever Wyoming enters into a cooperative agreement with the Secretary of the Interior pursuant to section 523(c) of SMCRA, DEQ and OSM will jointly review and act on mining and reclamation plans and permits to mines authorized under a federal coal lease.

The Land Quality Division would issue a permit and license to mine upon its approval of a mining and reclamation plan. The Air Quality Division would issue permits to construct and permits to operate crushers and other point sources after a review of applications with regard to air contaminants and plans for control and monitoring. The Water Quality Division would issue permits to construct waste water systems. They also would issue National Pollutant Discharge Elimination System (NPDES) permits for discharging waste water. The Solid Waste Division would issue construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation.

Wyoming State Engineer

Any storage, impoundment, or use of surface or groundwater for mining and coal processing operations would require a permit from the State Engineer.

Carbon County

That part of the proposed Cherokee project within the scenic corridor along Highway 789 in Carbon County would require a special use permit.

Sweetwater County

That part of the proposed Cherokee Mine in Sweetwater County would require a zoning variance approval from the Sweetwater County Planning Commission. A construction permit would also be required.

INTERRELATIONSHIPS

Relationship to Land Use Plans

Bureau of Land Management

Public land within the Cherokee project area was included in the BLM Management Framework Plan (MFP) for the Overland Unit. The proposed decision in this MFP is to allow development and mining of the coal.

Other MFP recommendations related to coal development are that the BLM provide additional land for community development in Rawlins, Saratoga, and Wamsutter. Land would be provided by the BLM for sanitary

landfills near Saratoga and in a central location for Hanna, Elk Mountain, and Elmo. There are plans for the BLM to allocate land for schools, parks, etc., for development of a water treatment plant in Rawlins, and for airport expansion in Rawlins. Preliminary sites have been recommended for these land transfers; however, final designations have not been made. The post mining land uses on the project area will be wildlife habitat and livestock grazing as recommended in the Overland MFP.

State, County, and Local

The Cherokee project area is zoned for ranching, agriculture, and mining; therefore, no conflicting uses are foreseen.

Relationship to Regional Development

Other Coal

The Cherokee Mine would produce all of the presently projected coal to be mined in the Overland area by 1985 and 1990 (10 million and 40 million tons, respectively). This production would be 8% of the regional production projections of 121.3 million tons by 1985 and 17% of 241.4 million tons by 1990.

Other Regional Development

The proposed Cherokee Mine would be developed during the same time frame (1980) as other coal mine development in the region (Hanna Basin), uranium development in the Red Desert and Baggs areas, the ongoing regional exploration and development of oil and gas, and the regional increase in general construction to meet population needs.

Relationship to Regional Impacts

Development of the Cherokee Mine would add to the cumulative regional demand for labor, and would compete with other development occurring in the same time frame.

Relationship to Rail Transportation System

The coal would be transported in unit trains via the rail spur to the Union Pacific main line, where it would continue to Midwest markets. Once full production was reached, the project would add eleven to twelve unit trains (loaded) per week to the projected regional increase in rail traffic.

CHAPTER 2

DESCRIPTION OF THE EXISTING ENVIRONMENT

CLIMATE

The climate of southcentral Wyoming is characterized by dry air masses, which are modified Pacific air masses moving eastward over the Rocky Mountains. The largest moisture source is easterly winds which provide most of the precipitation. Annual precipitation is low at 10 inches per year, most of which is the result of spring and early summer thunderstorm activity. The prevailing winds are south to southwest. Northerly and westerly winds are also common.

The proposed Cherokee Mine site is located about 24 miles southwest of Rawlins in Carbon and Sweetwater Counties in an area of gently rolling hills. Temperatures at the site average about 45°F annually. Winds are generally out of the southwest for much of the year with an average speed of 11 miles per hour (Figure CH2-1). Stable atmospheric conditions prevail about 80% of the time because of the cold temperatures and moderately strong winds.

In the area, surface-based inversions are frequent despite the high average wind speeds. They occur in the mornings between 75% and 85% of the time annually; most frequently in summer, least frequently in spring. During afternoons, they are uncommon except in winter when they are observed about one-third of the time. The mean annual lake evaporation is estimated to be 36 to 42 inches. See the Regional Analysis for a discussion of severe weather events that could influence reclamation success.

AIR QUALITY

Particulate air quality in undeveloped areas of southcentral Wyoming ranges from 19 micrograms per cubic meter ($\mu g/m^3$) to 31 $\mu g/m^3$ annual geometric mean as recorded at five state and privately operated particulate sampling sites. The mean concentration at the five samplers is 25 $\mu g/m^3$ and the median is 24 $\mu g/m^3$.

Existing particulate air quality at the Cherokee Mine site is best reflected by the data generated at the Patrick Draw Site during 1976. The high volume sampler operated 6 months from July through December of 1976. These samples produced a geometric mean of 22 $\mu g/m^3$ with maximum values of 53 $\mu g/m^3$ and 41 $\mu g/m^3$. The geometric mean is in agreement with the background particulate concentration estimated in the Wyoming Air Quality Maintenance area analysis of 23 $\mu g/m^3$. The particulate air quality at the Cherokee Mine site is considered to be 22 $\mu g/m^3$.

There has been no intensive monitoring of gaseous pollutants in the area. Sampling for sulfur dioxide, nitrogen dioxide and nonmethane hydrocarbons was conducted at the Patrick Draw Site for three months in 1976.

Though these data are not of sufficient duration to specifically quantify the presence of these pollutants in the area it may be interpreted as an indicator of these pollutant levels at the site. The arithmetic mean concentrations recorded for sulfur dioxide and nitrogen dioxide were 26 $\mu g/m^3$ and 19 $\mu g/m^3$ respectively (Wyoming Department of Environmental Quality 1977), both of which are well below the Wyoming State standard. Concentrations at the remote mine site are most likely somewhat lower than these concentrations since even fewer sources of these pollutants exist at the proposed site.

Visibility at the site ranges from less than 1 mile to greater than 60 miles throughout the year. Average visibility ranges from about 26 to 47 miles with greatest visibility occurring during spring and summer months.

GEOLOGY

Stratigraphy and Structure

According to the regional geologic map (Map 4 in Appendix A), the only formation that crops out in the area is the Wasatch Formation which consists of mudstones, sandstones, and thin coal seams of Early Eocene age (about 50 million years ago). However, an environmental study of the area prepared by Westinghouse Electric Corporation for Rocky Mountain Energy Company states that the coal seams to be mined are in the Fort Union Formation. The mining plan prepared by Pacific Power and Light Company (1976) includes a more detailed geologic map which shows the coal seams to be near the top of the Fort Union Formation. Apparently there is some uncertainty as to the location of the contact between the Fort Union and Wasatch Formations, and perhaps in its definition.

In any case, the two main and one minor coal seams that would be mined are stratigraphically near the top of the Fort Union or near the bottom of the Wasatch Formation. The main seams are 12 and 24 feet thick and are referred to as the upper and lower Cherokee seams (see section on Mineral Resources for details). The thickness

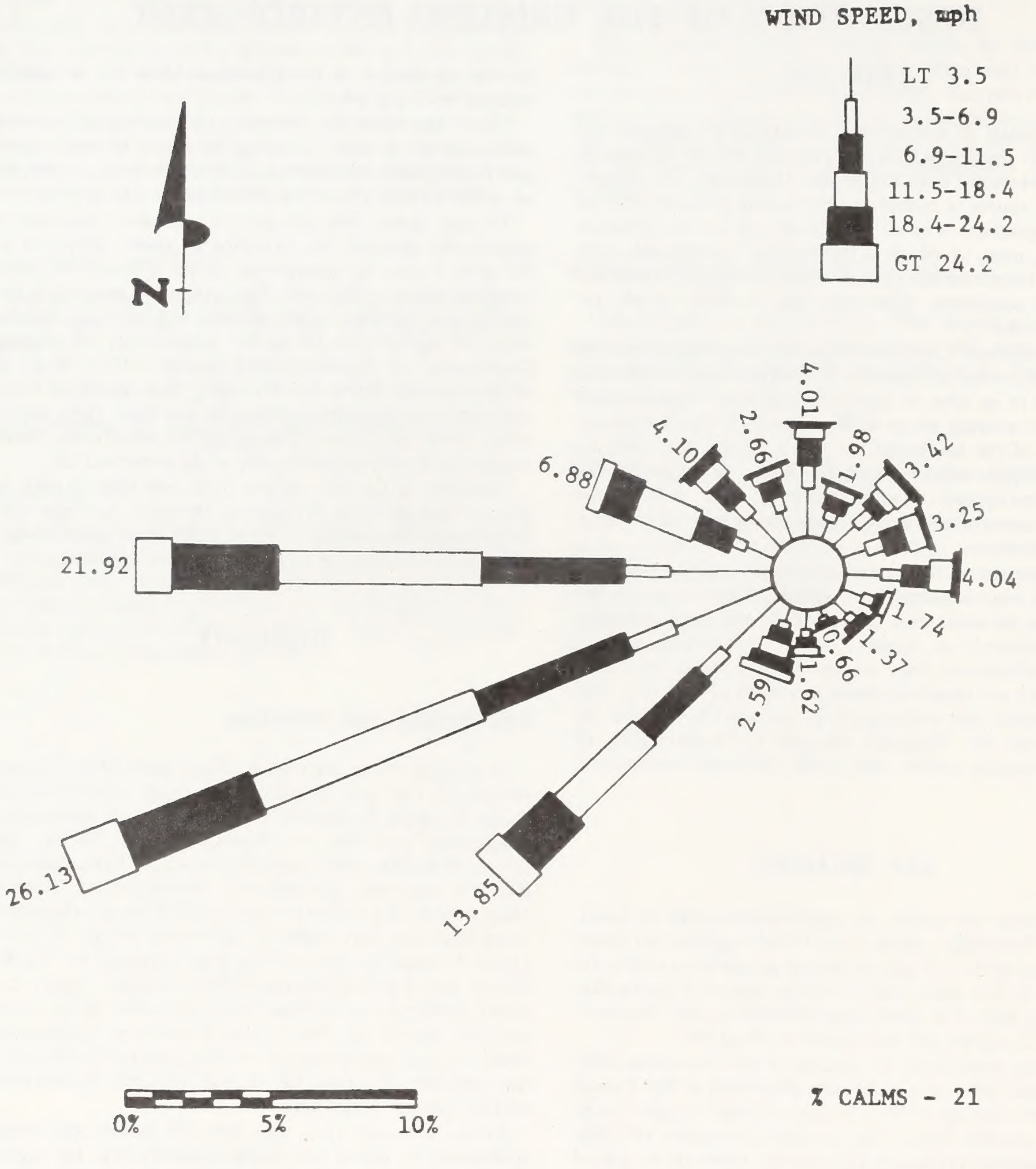


FIGURE CH2-1

ANNUAL WIND ROSE FOR THE PROPOSED
CHEROKEE MINE SITE

Source: National Climatic Center, STAR Program for Selected U.S. Cities, 1968. (Rawlins, Wyoming).

of the interburden between the coal seams ranges from 2 to 80 feet within the proposed mining area.

The proposed Cherokee project area is near the saddle between the Great Divide and Washakie Basins. The coal seams near the surface dip to the northwest at 1½ to 3½ degrees. At depths of 17,000 feet below the surface, the dip of the Lower Cretaceous Cloverly Formation is about 4 degrees. Thus, the strata from the surface to a depth of 17,000 feet are nearly horizontal.

Geologic Hazards

The Cherokee coal field is within an area of low seismicity (Algermissen and Perkins 1976), the closest suspected active fault is near Rawlins (see Map R2-6, Regional Analysis), thus there is little potential hazard from earthquakes. The formations to be mined are not known to be particularly susceptible to landsliding.

Paleontology

A preliminary survey of major unvegetated outcrops was made on the project area by Eaton in 1976. The Fort Union is the only fossiliferous formation in the project area. It is known to contain vertebrate and paleobotanical fossil materials of Paleocene age.

TOPOGRAPHY

The proposed project area has an average elevation of about 7.100 feet above sea level and a relief of 375 feet. The area lies just north of the western branch of the Continental Divide and thus, drains to the north into the Great Divide Basin (see Map 6 in Appendix A).

In detail, the level surface areas have a hummocky appearance in places due to the sloughing of beds into cavities created where coal has burned. Some windblown sands locally form a dune-type topography. The eastern part of the area has been somewhat dissected by stream erosion.

SOILS

Soil data for the Cherokee project area were taken from the Red Rim Area Soil Survey published by Soil Conservation Service (SCS) in cooperation with the Bureau of Land Management in April 1976. It was correlated and expanded with an unpublished soil survey done by the SCS in the summer of 1977 for the BLM. The soil survey conforms to the latest accepted practices of the National Cooperative Soil Survey Program using the New Soil Taxonomy, USDA 1975. The mapping units are based upon soil types with similar properties. Separation is at the association, complex, or series level. Additional units were not shown in each mapping unit if they were too small or complex to delineate, or the soil survey was not detailed enough to describe them.

Some of the principal soils found on the Cherokee project area that would be disturbed by surface mining are in mapping units 225, 247, 246, and 250 (see Map CH2-1). Soils of mapping unit 225 characteristically occur on rolling uplands and narrow valley slopes traversed by long, narrow, rough ridges. These sandy loam soils have moderate erosion hazard potentials, undulating to rolling slopes, and moderately deep depths, making them fair to good sources of soil material for reclamation.

The soils of mapping unit 247 characteristically occur on low rolling hills. These sandy loams and loams have moderate erosion hazard potentials, gently sloping to moderately steep slopes, and moderately deep depths, making them fair sources of soil material for reclamation.

The soils of mapping unit 246 characteristically occur on long, winding ridges, sidehill slopes, and narrow valleys. These sandy loam and loams have moderate erosion hazard potentials, rolling to steep slopes, and moderately deep to shallow depths, making them poor to fair sources of soil material for reclamation.

The soil of mapping unit 250 characteristically occurs on nearly level to gently rolling elevated terraces. This sandy loam soil has a slight to moderate erosion hazard potential, gently sloping to sloping slopes, and deep depths, making it a good source of soil material for reclamation.

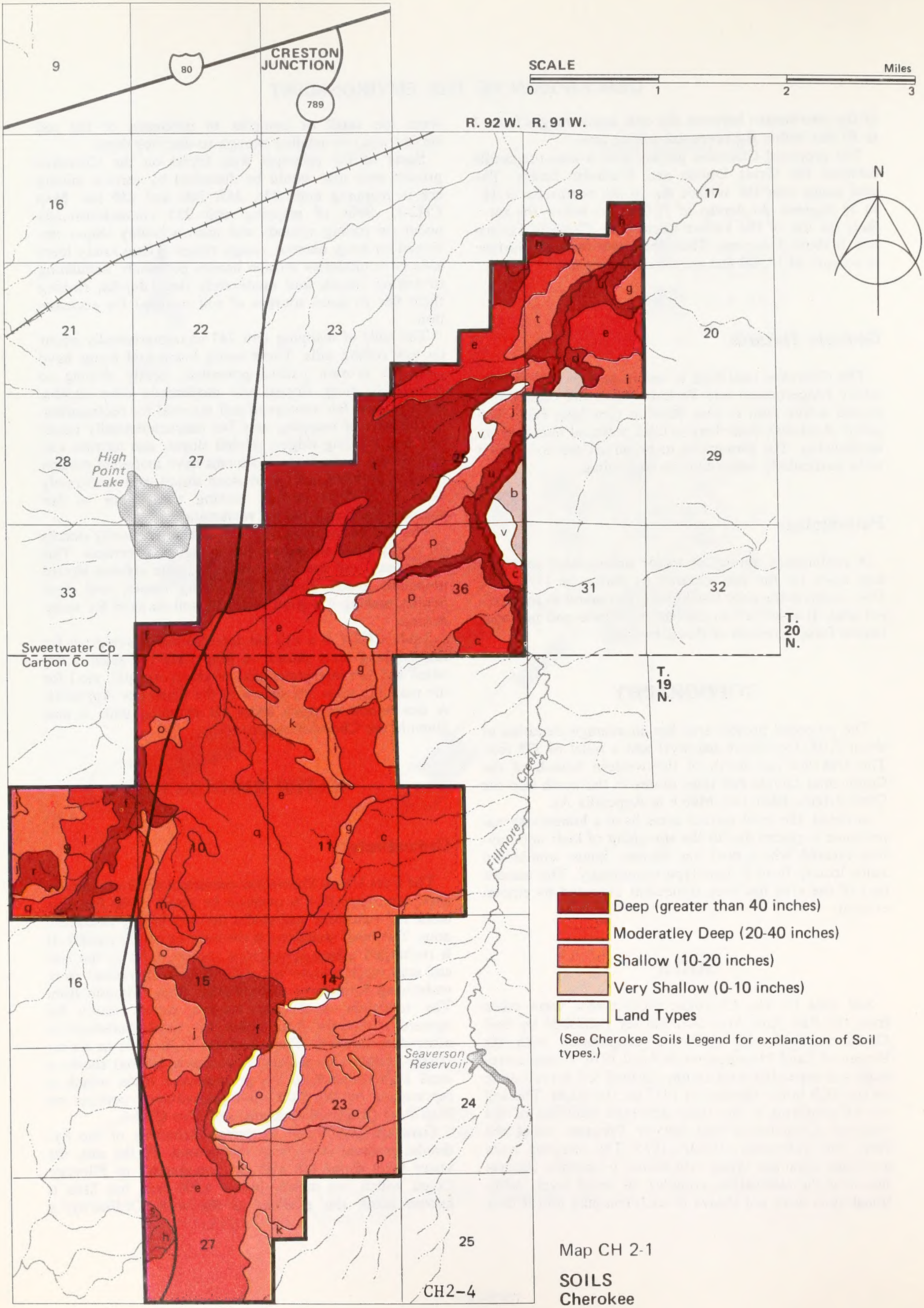
Table CH2-1 is a soil use interpretations summary for the mapping units shown on Map CH2-1. Tables of detailed soil use interpretations (productivity, pH, etc.) for the mapping units are shown in the Cherokee Appendix. A description of these order III mapping units is also given in the Cherokee Appendix.

WATER RESOURCES

Groundwater

The Fort Union Formation contains a thick continuous basal sandstone that is overlain by about 3,000 feet thin lenticular sandstone and shales that are mostly discontinuous. The basal sandstone is the only extensive aquifer. It is recharged where it outcrops several miles to the east and may receive some water by upward movement from underlying formations that outcrop along Altantic Rim. The lenticular sandstones receive water mostly by upward movement from either the basal sandstone or other deep aquifers. There appears to be little or no recharge within the project area. Davis (1976a) shows a local high (mound) in the groundwater table, which is represented by the 7,000 foot groundwater contour on Map R2-8 (Regional Analysis) and Map CH2-2.

Data are insufficient to permit definition of the hydraulic gradient away from this mound. To the east, the water level drops off with the topography to Fillmore Creek which lies mostly below 6,900 feet, but little is known about the gradient to the west. Ordinarily, a



Map CH 2-1

SOILS
Cherokee

CHEROKEE SOILS LEGEND

a. 37A, Fleutsch fine sandy loam, 0-3% slopes
b. 202,Tasselman-Shinbara complex, 6%-30% slopes
c. 207, Delphill-Blazon association
d. 210, Ravalli-Forelle-15 association
e. 225, Cushool-Rock River association
f. 231, Rock River-Cushool-Ryark association, valleys
g. 232, Blazon-Delphill-Diamondville complex, 6%-30% slopes
h. 234, Rock River-Ryark-Cushool association
i, 235, Blason-Shinbara complex, 6%-40% slopes
l. 236, Cushool-Worfman-Blackhall complex, 6%- 30% slopes
m. 237, Seaverson-Blazon complex, 3%-15% slopes
n. 238, Blanyon Variant-Bukley-Lisam association
o. 241, Diamondville-Blazon-Forelle association
p. 242, Blackhall-Blazon complex, 6%-30% slopes
q. 245, Abston-Rallod-Seaverson complex,3%-20% slopes
r. 246, Cushool-Rallod-Blazon association
s. 247, Cushool-Diamondville-Worfman complex, 3%-15% slopes
t. 248, Cothran-Crestman complex 6%-30% slopes
u. 249, Absher-Abston association
v. 250, Rock River sandy loams, 3%-9% slopes
w. 320, Monte-Clowers complex, 0-3% slopes
x. 401, Rockland Land Type

Table CH2-1

SOIL INTERPRETATION SUMMARY

Soil Unit		Erosion Hazard Potential[1]		PSIAC[2]			Suitability for Final Cover for Mined Land[3]		Range Site[4]	Capability Group[4]		Estimated Acres in Project Area[5]		Vegetative Type[6]
Symbol	% Slopes	Water	Wind	Rating	Ac Ft/SqMi/Yr	Ton/Ac/Yr	In. Avail.	Suitability		Dryland	Irrigated	Acres	Percentage	
37A	0-3	L	L	18-23	0.16-0.22	0.4-0.6	26-60	H	Loamy	VIe2	IIIc2	96	0.9	4
202	6-15	M	L	30-40	0.24-0.34	0.8-1.0	0	L	Sh. Sandy	VIIe14		102	0.9	8
	15-30	M	M						V. Shallow	VIIs17				
207	6-15	M	M	45-50	0.41-0.50	1.2-1.6	0-10	L	Loamy	VIe2		612	5.7	4
	15-30	H	M						Sh. Loamy	VIIe14				
210	0-3	L	M	24-29	0.20-0.24	0.6-0.8	14-60	M-H	Saline & Upland	VIIs17		32	0.3	13
	3-6	M	M						Loamy	VIe2				
225	3-6	L	M	21-25	0.18-0.2	0.5-0.6	18-60	M-H	Loamy	VIe2		2,240	21.1	4
	6-10	M	H											
231	3-6	L	L	18-23	0.16-0.19	0.4-0.6	18-60	M-H	Loamy	VIe2		640	5.9	4
	6-15	M	M						Sandy	VIe5				
232	6-15	H	M	40-49	0.34-0.48	1.0-1.6	0-10	L	Sh. Loamy	VIIe14		160	1.5	4
	15-30	H	M						Loamy	VIe2				
234	0-3	L	L	21-26	0.18-0.21	0.6-0.7	18-60	M-H	Loamy	VIe2		128	1.2	4
	3-6	M	H											
	6-15	H	H						Sandy	VIe5				
235	6-15	H	M	49-58	0.48-0.66	1.5-2.1	0-6	L	Sh. Loamy	VIIe14		230	2.1	4
	15-40	H	H						V. Shallow	VIIs14				
236	6-15	H	M	48-57	0.46-0.64	1.5-2.1	0-18	L-M	Loamy	VIe2		371	3.5	4
	15-30	H	H						Sh. Loamy	VIIe14				
									Sh. Sandy	VIIe14				
237	3-6	M	L	29-41	0.24-0.36	0.8-1.1	0-6	L	Sh. Loamy	VIIe14		448	4.1	4
	6-15	M	M											
238	3-6	M	M	38-44	0.32-0.40	0.9-1.2	0	L	Clayey	VIe2		90	0.8	4
	6-15	M	H						Sh Clayey	VIIe14				
	15-20	H	H											
241	3-6	M	M	32-40	0.26-0.34	0.8-1.0	6-23	M	Loamy	VIe2		160	1.5	4
	6-15	H	M						Sh. Loamy	VIIe14				

Table CH 2- 1 (continued)

SOIL INTERPRETATION SUMMARY

Soil Unit		Erosion Hazard Potential[1]		PSIAC[2]			Suitability for Final Cover for Mined Land [3]		Range Site [4]	Capability Group [4]		Estimated Acres in Project Area[5]		Vegetative Type [6]
Symbol	% Slopes	Water	Wind	Rating	Ac Ft/SqMi/Yr	Ton/Ac/Yr	In. Avail.	Suitability		Dryland	Irrigated	Acres	Percentage	
242	6-15	H	H	40-48	0.34-0.46	1.0-1.5	6-17	L-M	Sh. Sandy	VIIe14		154	1.4	4
	15-30	H	M						Sh. Loamy	VIIe14				
245	3-6	M	H	34-42	0.28-0.37	0.8-1.2	0	L	Saline-Upland	VIIs17		371	3.5	4a
	6-15	H	H						Sh. Loamy	VIIe14				
	15-30	H	H											
246	6-15	M	M	32-40	0.26-0.34	0.8-1.0	0-18	L-M	Loamy	VIe2		1,660	15.6	4
	15-30	M	M						Sh. Loamy	VIIe14				
247	3-6	M	M	26-30	0.21-0.24	0.6-0.8	10-23	M	Loamy	VIe2		1,372	13.0	4
	6-15	M	M						Sh. Loamy	VIIe14				
248	6-15	M	H	30-36	0.24-0.30	0.8-0.9	0	L	Sandy	VIe5		64	0.6	4
	15-30	M	H						Sh. Sandy	VIIe14				
249	0-3	L	H	20-27	0.17-0.22	0.4-0.6	0	L	Saline-Upland	VIIs17		13	0.1	4a
	3-6	M	H											
250	3-6	L	L	18-27	0.16-0.22	0.4-0.6	26-60	H	Loamy	VIe2	IIIc2	1,101	10.5	4
	6-9	M	L											
320	0-3	L	L	18-23	0.16-0.19	0.4-0.6	0-60	M	Loamy 7-9	VIe2		333	3.1	14
401		H					0	L	None	VIIIs83		294	2.7	8

1 Erosion hazard classes or susceptibility of the soil to erosion when no cover is present from (BLM 7317.1 and soil profile descriptions in USDA, SCS 1978, 1977, 1976, and 1972. L--Low (Slight) M--Moderate H--High (Severe)

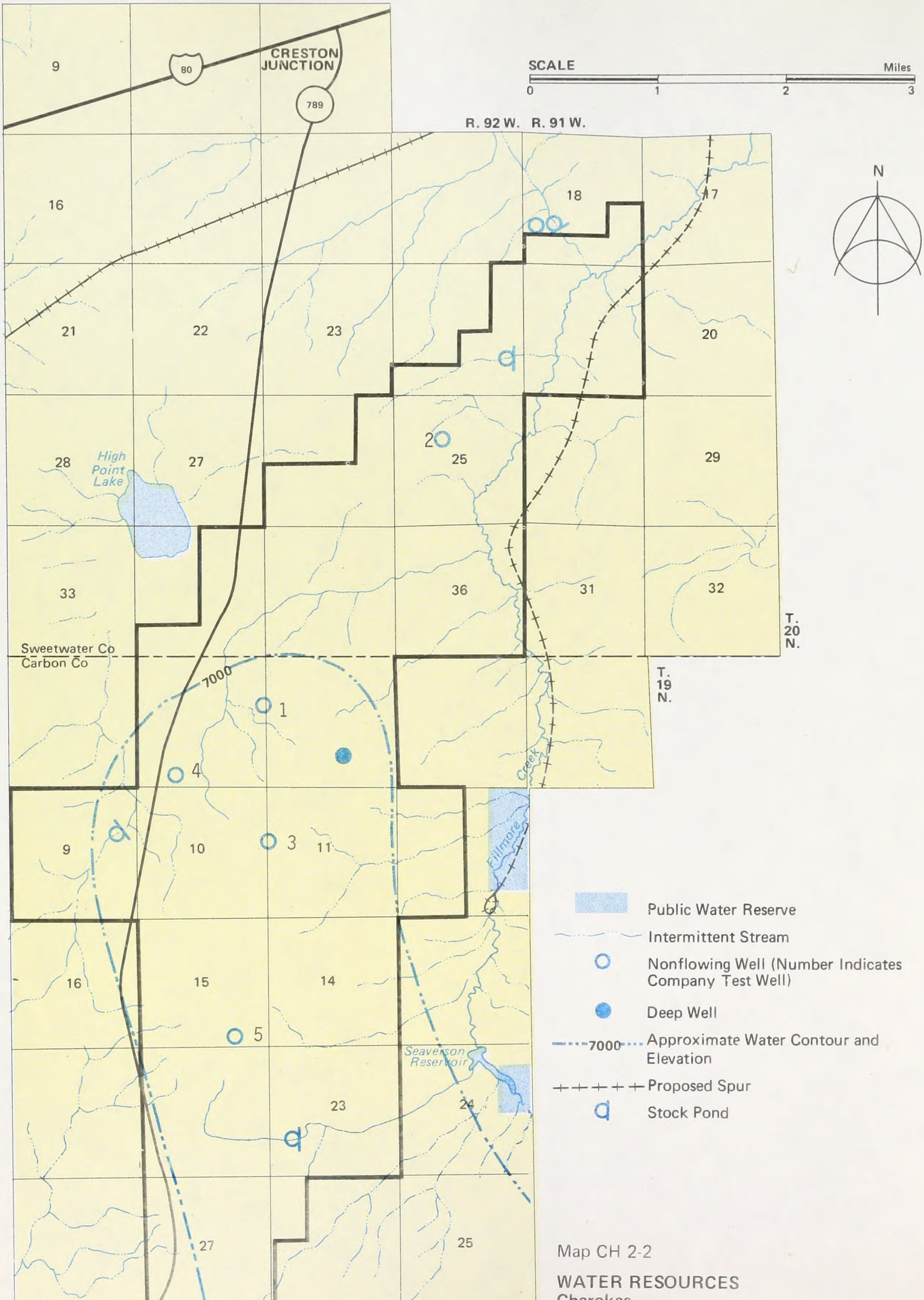
2 Estimated present erosion rates (Pacific Southwest Inter-Agency Committee 1968)

3 Estimated soil suitability for reclamation of minedland (BLM 7312); L--Low (Poor), M--Moderate (Fair), and H--High (Good)

4 Soil survey legend and interpretations SSA731 (January 1978)

5 Total acres and % of total acreage for each soil association occupies within project area.

6 Vegetative types adapted to and likely to occur on soil types (see Vegetation section and Vegetation Map HS 2-3.



Map CH 2-2

WATER RESOURCES
Cherokee

mound would infer recharge by infiltration from above. However, since vertical gradients are universally upward in this area, it appears that the mound is caused by water moving upward from deeper aquifers, then moving laterally to be discharged into local topographic lows. Fillmore Creek alluvium probably receives a few gallons per day from this upward movement.

Unconfined water table conditions exist in coal seams lenticular sandstones overlaying the coal. Depth to water in the unconfined aquifers is generally 60 to 90 feet. Artesian conditions exist in deeper layers. Test wells encountered artesian pressure at depths of 200 feet or more. Water in one well stood 170 feet above where water was encountered, indicating a pressure of 76 pounds per square inch (psi) at a depth of 200 feet. Water levels and aquifer characteristics are unknown around Cow Butte Basin where the company plans to deposit ~~waste~~ from washing coal.

Permeabilities, storage coefficients, and transmissivities of the coal and shallow sandstones at the mine site are low. Representative ranges for various hydraulic characteristics are: permeability 0.13 to 4.7 gallons per day per square foot (gpd/ft^2), storage coefficient 2 x 10^{-4} to 2 x 10^{-7}, and transmissivity 1.6 to 128 gpd/ft. A Pacific Power and Light Company well drilled to a depth of 3,445 feet near the center of the project area apparently penetrates the basal sandstone. The well yielded 325 gallons per minute (gpm) with a drawdown of 170 feet during a test of unknown duration. According to the company geologist (personal communication) the well could yield up to 500 gpm, but there is no indication of how long such a yield could be maintained.

There are no known springs in the project area; the nearest spring is 1 mile south of the project in Section 32, T. 17 N., R. 92 W.

Surface Water

There are no perennial streams within the Cherokee project area. The area is drained by small ephemeral tributaries to two closed basins and Fillmore Creek, which passes along the eastern edge of the project. Fillmore Creek drains to a closed basin by way of Separation Creek. Drainage from the mine site would enter the creek downstream from Seaverson Reservoir, the most downstream reservoir. Most of the Cherokee area drains into Fillmore Creek. The creek is dry most of the year. Flows are expected only from major storms and rapid spring thaws. There is no record of streamflow at the project, but on the basis of the general regional hydrology, it can be assumed that the tributaries which drain the mine area will flow less than 5% of the time.

On the basis of channel geometry, the bank-full discharge of Fillmore Creek is estimated to be 20 cubic feet per second (cfs) at sites about 1 mile below Seaverson Reservoir and just downstream from the Cherokee project. The annual runoff is estimated to be less than 100 acre feet at the upper site and approximately 150 acre feet at the lower site.

Floods may occur in a few streams as a result of intense local thunderstorms, but these would have little significance because the largest watershed in the mine area covers less than 2 square miles. The mean annual flood from such a basin is estimated to be 70 cfs and the 10-year flood is estimated to be 150 cfs. The 10-year flood would last less than 6 hours, and the total volume of flow during the vent would be about 20 acre feet; the volume of flow during a 100-year flood would be 700 acre feet.

WHERE?

Quality

Groundwater in the coal and overlying aquifers is generally human consumption, because the total dissolved solid (TDS) concentrations range from 2,040 to 3,760 milligrams per liter (mg/l). The limit for human consumption is generally considered to be about 1,000 mg/l. Sulfate values range from 111 to 1,333 mg/l which makes water from some areas unfit for livestock consumption. Although the dissolved boron level is relatively low, less than 0.2 mg/l, salinity values and sodium absorption ratios, up to 74 in nearby wells, are too high for use for irrigation of many crops.

Water from the basal sandstone is potable, containing less than 1,000 mg/l of TDS at Pacific Power and Light's deep well. The better quality at depth agrees with findings by Davis (1976a), who states that water in deep aquifers is of good quality comparable to that found near the recharge area where TDS concentrations are generally less than 1,000 mg/l.

The occasional flows of surface water are probably also of poor quality, but are suitable as a water supply for stock and wildlife. No chemical analyses have been made of surface water at the site.

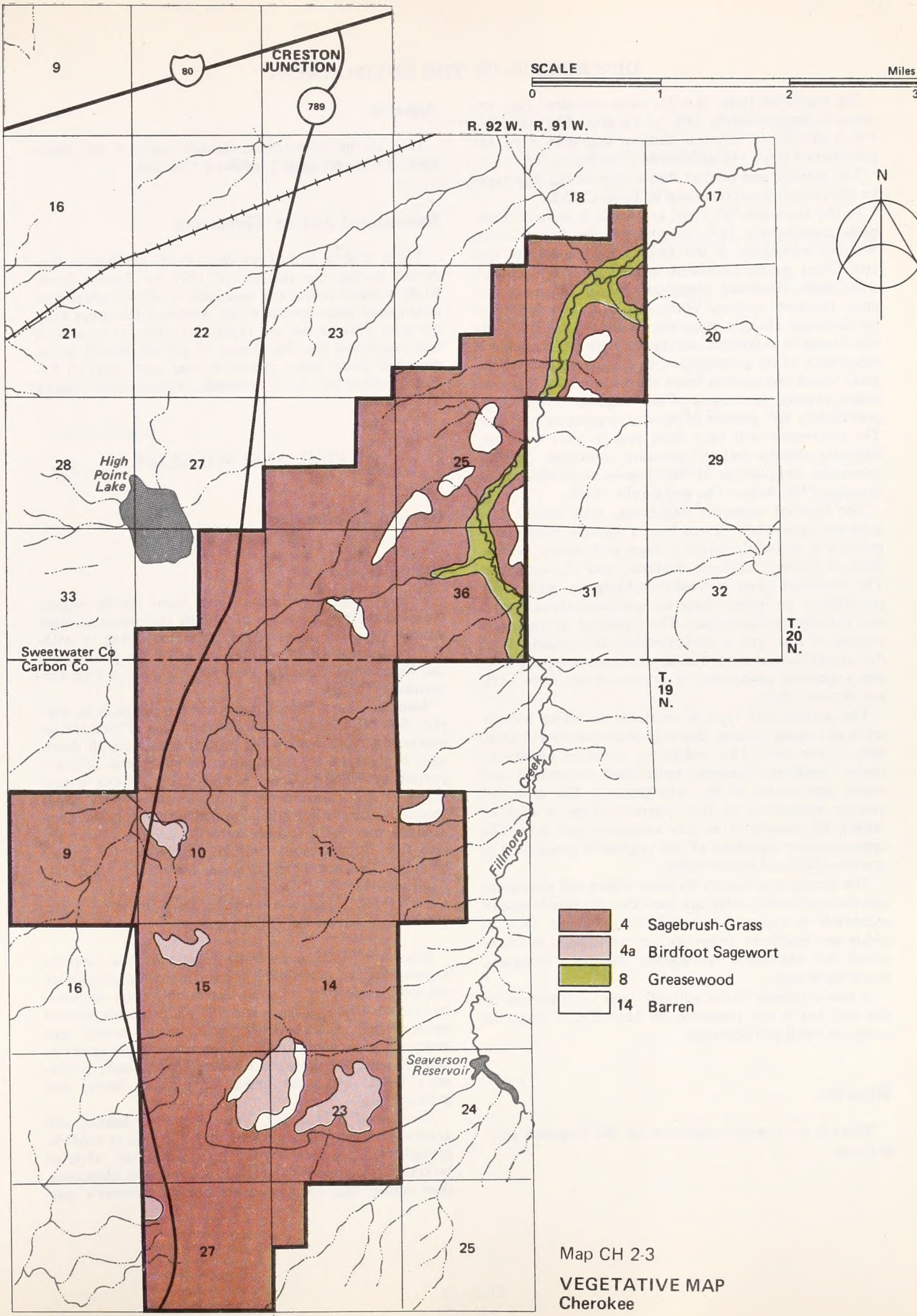
Water Use

The mine plan shows two wells just outside the project boundary. The BLM (1976) shows another three wells within 1 mile of the project. No information is given on the use of these wells, but it has been assumed that they are used for stockwater. Three stock ponds are located within or immediately outside the area proposed for mining.

VEGETATION

Terrestrial

Vegetative cover on the Cherokee project area is composed of one major and three minor types. For a general description of these types, refer to the Regional, Chapter 2, Vegetation. The geographic locations of the range types on the project area are shown on Map CH2-3.



Map CH 2-3

VEGETATIVE MAP
Cherokee

Big sagebrush (type 4) is the most prevalent type and occupies approximately 92% of the area. The remaining 8% is distributed between birdfoot sagewort (type 4a), greasewood (type 14), and barren (type 8).

The acreage and percent distribution of the four types on the project area are shown in Table CH2-2.

In the big sagebrush type, sagebrush is heavily dominant, contributing 35% to 40% of the living cover. Western wheatgrass is the second most important species. Other species prevalent in the type are bluebunch wheatgrass, Sandberg bluegrass, Indian ricegrass, and other bluegrass species. Within the area, the density of the big sage changes from site to site. Correlated with this change in sagebrush density is a noticeable change in the density of the graminoides, especially western wheatgrass which increases in lesser sagebrush areas. The estimated average production of this vegetative type is approximately 885 pounds of air dry vegetation per acre. The production will vary from year to year with variances in climatic and soil moisture conditions. The approximate composition of this vegetative production is; grasses—17%, forbs—1%, and shrubs—82%.

The birdfoot sagewort (sagebrush) type appear as a grassland type when viewed from a distance. Shrub composition is primarily birdfoot sage with minor populations of Gardner saltbush, winterfat, and big sagebrush. The dominant grass is western wheatgrass with minor populations of Indian ricegrass, needleandthread grass, and bottlebrush squirreltail. The estimated average production of this type is approximately 345 pounds of air dry vegetation per acre. The approximate composition of this vegetative production is; grasses—44%, forbs—1%, and shrubs—55%.

The greasewood type is restricted to saline bottomlands and along washes. Black greasewood covers about 56% of the sites. The understory cover of grasses includes Sandberg bluegrass, bottlebrush squirreltail, and minor populations of the wheatgrasses. The estimated average production of this vegetative type is approximately 850 pounds of air dry vegetation per acre. The approximate composition of this vegetative production is; grasses—12% and shrubs—88%.

The barren type occurs on areas where soil conditions and moisture relationship are such that the dominance of sagebrush is replaced by cushion-like plants such as phlox and sandwort. Other species represented in sparse stands are bluebunch wheatgrass, Sandberg bluegrass, and fringed sage.

A minor amount of the saltbush (type 13) is present on the site, but is not presented on Map CH2-3 since the areas are small and scattered.

Riparian

There is no riparian vegetation on the proposed project area.

Aquatic

Due to the intermittent characteristics of the drainages, there is no aquatic habitat on the site.

Endangered and/or Threatened

There is no record of nor did a field examination conducted during the summer of 1977 by Robert Dorn, BLM botanist reveal the existance of any threatened or endangered plant species in the proposed Cheorkee project area. Due to the soil types that exist in the area, it was concluded that the chance of any threatened or endangered plants being present is near zero (refer to Regional, Chapter 2, Vegetation, Endangered and/or Threatened).

FISH AND WILDLIFE

General Information

Habitat Types

Primary vegetative habitat types found on the project area and the major species of wildlife that occur in these various types are listed below. A partial listing of wildlife species that could possibly occur on the project site can be obtained from the Wyoming Game and Fish Department (1977d).

Aquatic. There is no aquatic habitat adequate to support fish life located on the project area. There are no perennial streams within the project area since all drainages in the area are intermittent or ephemeral. While a portion of Fillmore Creek is within the project boundary, it is also intermittent. There are three stock ponds located within or immediately outside the proposed project area that could furnish water to wildlife. There are also five flowing wells within 1 mile of the project boundary that could furnish water for wildlife (Map 6A, Appendix A).

Terrestrial. Vegetation noted below is found on dryer, upland sites within the project area.

Sagebrush (9,838 acres). This vegetative type supports a great variety of wildlife species including pronghorn antelope, mule deer, coyote, desert cottontail, whitetail jackrabbit, Uinta ground squirrel, Richardson's ground squirrel, deer mouse, Great Basin pocket mouse, sage grouse, Brewer's sparrow, sage sparrow, vesper sparrow, sage thrasher, green-tailed towhee, horned lark, Swainson's hawk, red-tailed hawk, ferruginous hawk, and golden eagle.

Greasewood (327 acres). This vegetative habitat will generally support the following major species of wildlife: pronghorn, mule deer, coyote, desert cottontail, whitetail jackrabbit, Richardson's ground squirrel, least chipmunk, deer mouse, sage sparrow, sage thrasher, Brewer's spar-

Table CH2-2

VEGETATIVE DISTRIBUTION BY ACRES AND PERCENT
ON PROJECT AREA

TYPE	TYPE NO.	VEGETATIVE DISTRIBUTION	
		Acres	Percent
Big Sagebrush	4	9,838	92.2
Birdfoot sagewort	4a	300	2.8
Greasewood	14	327	3.1
Barren	8	206	1.9
Total		10,671	100.0

row, vesper sparrow, horned lark, sage grouse, marsh hawk, red-tailed hawk, and golden eagle.

Birdfoot Sagewort (300 acres). This vegetative type will generally support the same species of wildlife that occur in the big sagebrush type. The major wildlife species found in this type are listed above in the section on sagebrush.

Barren (206 acres). This type is used by wildlife only as travel area and will not support many species of wildlife.

General. Reptile and amphibian population numbers on the project site are moderate at best. Scant populations, according to the literature, of eastern fence lizards, northern plateau lizards, northern side-blotched lizards, Great Basin gopher snake, wandering garter snake, and prairie rattlesnakes could be found on the site. Little riparian vegetation and free water exists on the site to provide significant habitat for amphibians.

Wildlife

Birds

Nongame. Raptors common to the project area are golden eagles, marsh hawks, ferruginous hawks, and American kestrels. The shallow, sage-covered draws that characterize this area furnish excellent nesting habitat for marsh hawks, but little other nesting habitat is available on site for other species of raptors. The entire area, however, is hunting habitat for all species of raptors (Map 8A in Appendix A).

About eighteen species of songbirds can be found on site; the most common being horned larks, sage thrashers, and Brewer's sparrow.

A tentative listing of all the bird species which could occur in the region can be obtained from the Wyoming Game and Fish Department (1977d).

At the present time, best density estimates of small birds indicate that there are about 8 to 40 breeding pairs of small birds per 100 acres when averaged over these vegetative types (personal communication, Max Schroeder, USFWS, March, 1978).

Game. The entire project area of 10,671 acres is classified by the Wyoming Game and Fish Department as year-round sage grouse habitat (see Map CH2-4). There are also about 8,841 acres of crucial grouse wintering habitat on the project area (Map 8, Appendix A). Two strutting grounds or leks are located on the project area and another lek is located on a dry lake bed immediately adjacent northeast of the site (see Figure CH2-2). Since it is the tendency of sage grouse to nest within 2 miles of a lek, about 99% of the project area is also classified as crucial nesting habitat. The birds occur throughout the project area in the spring and early summer, but concentrate near water sources in late summer and fall.

Mourning doves also occur on the project area during the late spring to early fall period. Most of the nesting on the project area takes place on the ground since tree habitat is virtually nonexistent. These birds may nest as many as two to four times each year.

Mammals

Nongame. According to sightings and a search of current literature, (Burt and Grossenheider 1964; Wyoming Game and Fish Department 1977d), there are at least eighteen species of small nongame animals that could occur on the project area during some portion of the year. Some of the more common species that could be found on site are; deer mouse, Richardson's ground squirrel, whitetail jackrabbit, and coyote. The best density information presently available indicates that there are about 5 to 20 small mammal species per acre, averaged over the vegetative types found on the project area, consisting of about 10 to 100 individuals, or a total estimated density of from 50 to 200 small mammals per acre (personal communication, Dr. Jack Turner, January 1978).

Predator density appears to be quite high in this area, since a predator scent post transect run on the area in 1977 gave a very high index of predator abundance. All of the visits were by coyotes (Wyoming Game and Fish Department 1977d). A partial listing of small nongame mammals that could occur on the area can be obtained from the Wyoming Game and Fish Department (1977d).

Game. Pronghorns occur somewhere throughout the project area year-round (see Figure CH2-3). During summer months they can be found on all portions of the site, while late fall and winter find concentrations of these animals in the northeast corner of the site and along the western portion of the area near Highway 789 (Map CH2-5). These two winter concentration areas are part of crucial winter ranges extending outside the project boundary (see Map 8 in Appendix A).

The project area provides habitat for about 80 animals in the summer and 250 in winter. A significant amount of fawning and rearing of young also takes place on the area.

The Wyoming Game and Fish Department classes the eastern portion of the project area as year-round and winter deer range (Map CH2-5). The remaining habitat on the site would be classed as marginal deer range.

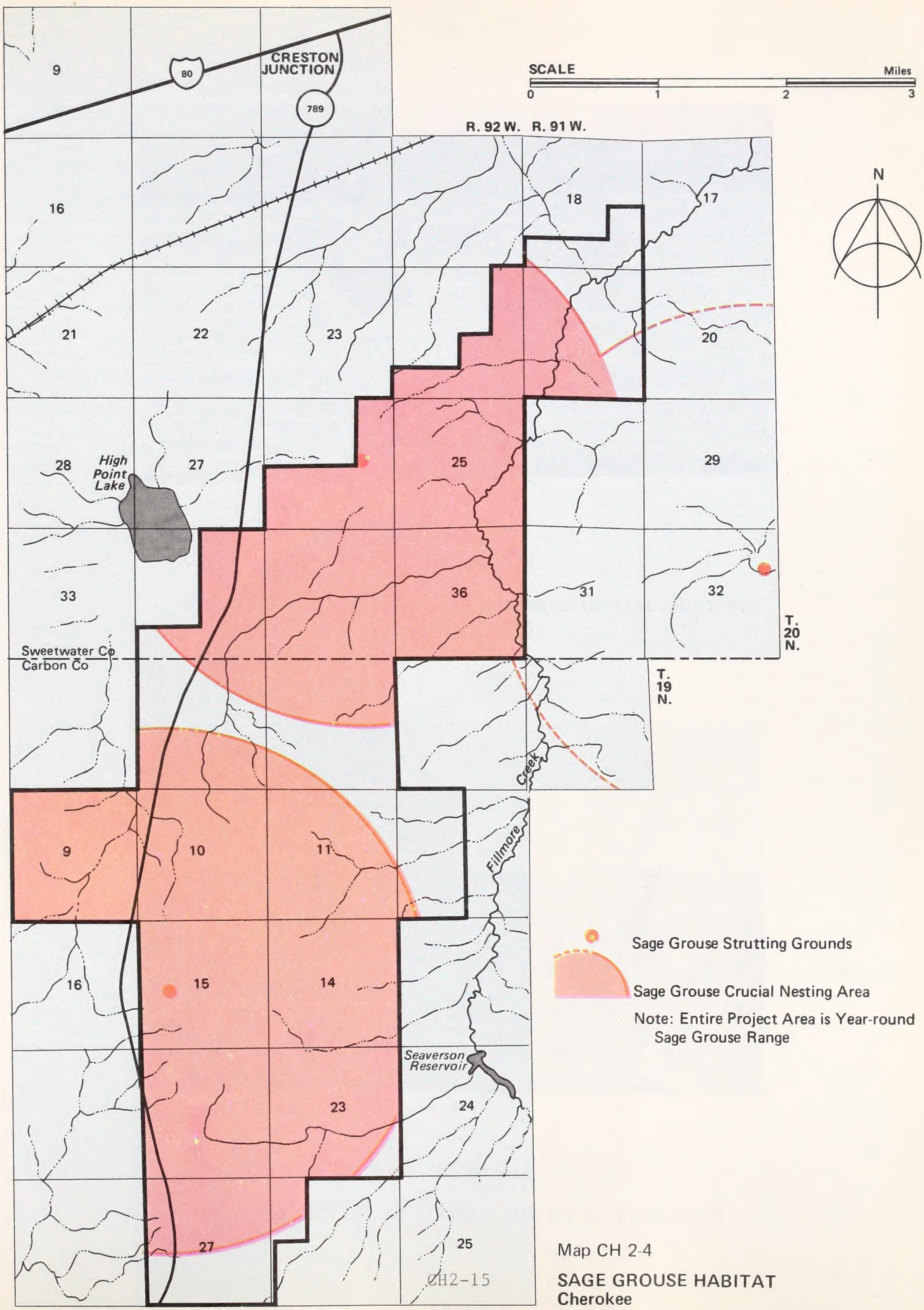
Depending upon the severity of the winter, a small population of deer may winter on the northern portion of the area. Numbers of mule deer are not high on the area at any time, rarely exceeding ten animals.

The desert cottontail rabbit is a very common small game mammal on the project area. The Wyoming Game and Fish Department (1977d) estimates that there are about five rabbits per acre in these vegetative types.

Reptiles and Amphibians

General

Reptile and amphibian numbers appear to be low on the project area. Some of the more common species that could be expected to occur on the site are; northern side-blotched lizard, northern shorthorned lizard, eastern fence lizard, and the western rattlesnake. There is little riparian vegetation and very little free water on the area which would provide habitat for any kind of amphibian.



Map CH 2-4

SAGE GROUSE HABITAT
Cherokee

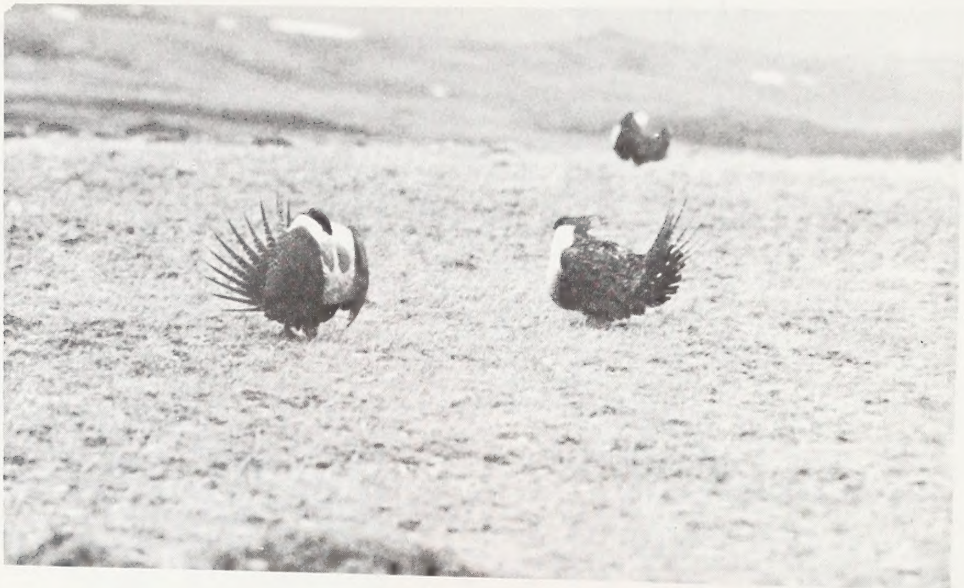
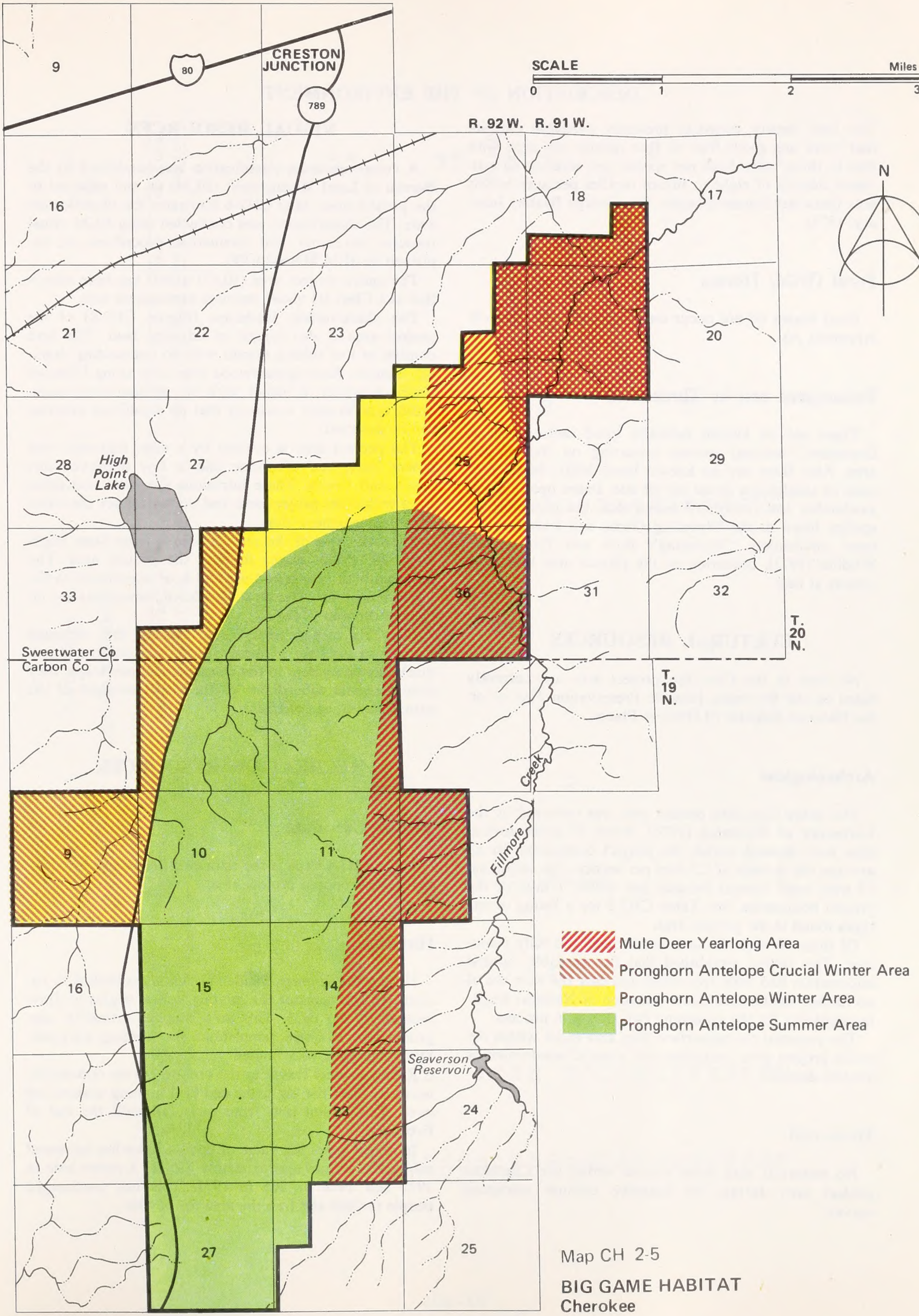


Figure CH2-2

STRUTTING MALE SAGE GROUSE ON A LEK LOCATED WITHIN THE PROJECT AREA

Figure CH2-3

PRONGHORNS IN TYPICAL HABITAT ON THE PROJECT AREA



Map CH 2-5

BIG GAME HABITAT
Cherokee

The best density estimates presently available indicate that there are about four to five species per acre with two to three individuals per species per acre, or an estimated density of eight to fifteen reptiles per acre in this area (personal communication, Dr. George Baxter, January, 1978).

Feral (Wild) Horses

Feral horses do not occur on the project area (Map 9, Appendix A).

Endangered and/or Threatened

There are no known federally listed endangered or threatened mammal species occurring on the project area. Also there are no known listed birds, fishes, reptiles, or amphibians found on the site. Based upon habitat availability and records of occurrence, the possibility of species listed in the Wyoming Game and Fish Department publication, "Wyoming's Rare and Endangered Wildlife"(1973), occurring on the project area would be remote at best.

CULTURAL RESOURCES

No sites in the Cherokee project area are currently listed on the Wyoming Historic Preservation Plan or on the National Register of Historic Places.

Archeological

The entire Cherokee project area was surveyed by the University of Wyoming (1976). Some 45 archeological sites were located within the project boundaries for an average site density of 2.7 sites per section. An additional 13 sites were located outside, but within 1 mile of the project boundaries. See Table CH2-3 for a listing of site types found in the project area.

Of these 58 sites, 56 have been tested and fully evaluated. This testing established that the available cultural information had been recovered and that the sites are of no further significance. Determination of National Register eligibility for the remaining two sites is in process.

The potential for subsurface sites also exists within the entire project area, particularly in areas of windblown or alluvial deposits.

Historical

No historical sites were located within the Cherokee project area during the intensive cultural resources survey.

VISUAL RESOURCES

A visual resources classification was conducted by the Bureau of Land Management (BLM) on and adjacent to the project area. Map CH2-6 illustrates the classification zone. The classification was conducted using BLM visual resource inventory and evaluation procedures as explained in BLM Manual 6300.

The entire project area (10,671 acres) has been identified as a Class III visual resource managment area.

The characteristic landscape (Figure CH2-4) of the project area is also typical of adjacent land. The land consists of low rolling terrain with no outstanding drainage features. Some greasewood does exist along Fillmore Creek; however, it blends with the predominately sagebrush type in such a manner that no significant contrast can be detected.

The project area is crossed by a state highway, two power lines, one telephone line, a few improved dirt roads, and fences. These intrusions are most noticeable from within the project area and do not reduce the value of the management class.

The best view of the project area is from State Highway 789, which passes through the project area. The road has high year-round use and is of importance to the visual sensitivity. The most significant viewpoints are indicated on Map CH2-6.

Class III management would require that although changes in the basic elements (form, line, color, and texture) may be evident in the characteristic landscape, they should remain subordinate to the visual strength of the existing landscape character.

RECREATION RESOURCES

Visitor Use Data

Table CH2-4 depicts the estimated visitor use by activity in the proposed project area.

Hunting

During the summer, incidental hunting is limited to rodents. In late summer the hunting season begins to draw hunters to the field. This area supplies primarily sage grouse and antelope populations for hunting purposes. Deer hunting is very limited.

Rabbit hunters travel to the area to pursue cottontails, normally after the big game and bird hunting seasons are over. This season lasts from early fall until the end of February.

In recent years the value of coyote hides has increased substantially from approximately $35 for a prime hide in 1975 and 1976 to $65 in 1977. This has encouraged people to hunt and trap the area for coyote.

Table CH2-3

CULTURAL RESOURCES

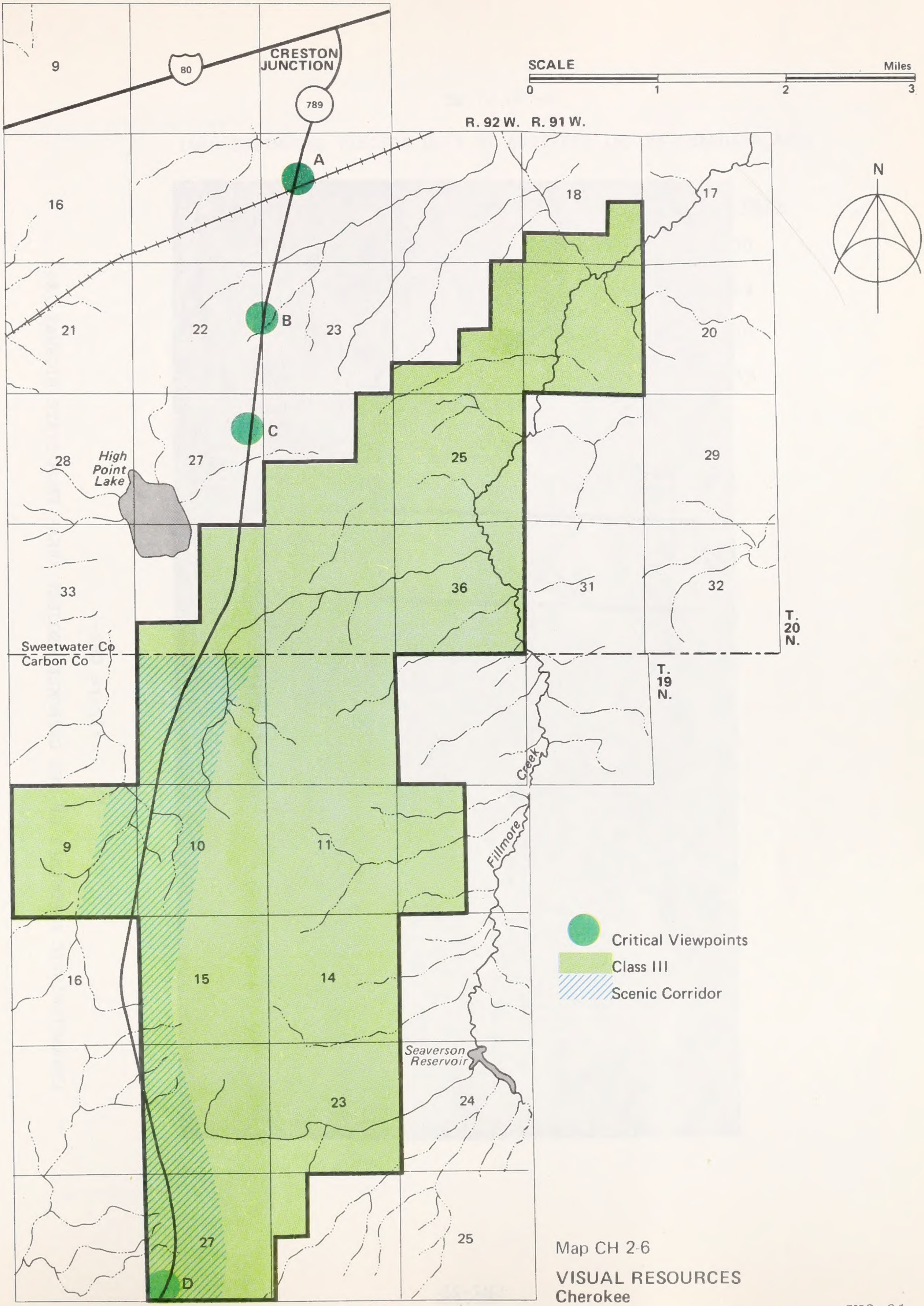
Site Number	Within Project	Outside Project	Campsite	Stone Ring	Isolated firepit/ Firecracked rock	Chipped Stone	Ground Stone	Rock Shelter	Bone/ Shell	Cultural Period
1		1			1	1				
2		2			2					
3		3			3	3				
4		4	4							
5	5		5			5				
6	6					6				
7		7	7			7			7	
8		8	8			8				LP
9		9	9			9	9			LP
10	10					10				
11	11				11	11				
12	12		12	12		12				
13	13					13				
14	14				14	14				LP
15		15	15			15				LP
16	16		16			16				
17	17		17			17				MPA/LPA
18	18		18			18				LP
19	19					19				
20		20	20			20	20			LP
21	21		21	21		21		21		
22	22		22			22				
23	23		23			23				
24	24					24				
25	25					25				
26	26					26				LP
27	27					27				
28	28					28	28			
29	29				29	29				
30	30					30				
31	31					31				
32	32				32	32				LP
33	33		33			33				LP

Table CH2-3 (Continued)

CULTURAL RESOURCES

Site Number	Within Project	Outside Project	Campsite	Stone Ring	Isolated firepit/ Firecracked rock	Chipped Stone	Ground Stone	Rock Shelter	Bone Shell	Cultural Period
34	34					34				LP
35	35		35			35				
36	36		36	36		36				LP
37	37					37				
38	38		38			38				
39	39		39			39				LP
40	40				40	40				
41	41		41			41				
42	42				42			42	42	
43	43		43			43				LP
44	44				44	44				MPA/LPA
45	45				45			45		
46	46		46			46				
47	47		47							
48	48		48							
49	49		49							
50	50		50							
51	51		51							
52	52					52				LP
53	53		53			53				
54		54	54			54	54			MPA/LPA
55		55	55			55				LP
56		56	56			56	56			LPA/LP
57	57				57	57			57	LPA/LP
58		58	58			58				MPA/LPA

LP = Late Prehistoric
MPA = Middle Plains Archaic
LPA = Late Plains Archaic



Map CH 2-6

VISUAL RESOURCES
Cherokee

Figure CH2-4

CHARACTERISTIC LANDSCAPE OF THE CHEROKEE PROJECT AREA--FROM STATE HIGHWAY 789

Table CH2-4

1976 ESTIMATED VISITOR DAYS BY ACTIVITY IN THE CHEROKEE AREA

Activity	Visitor Days
Hunting (Big Game)	50
Sightseeing, Incidential	2,969
Off-Road Vehicle	20
Total	3,039

Note: Visitor day considered to be 12 hours.

Source: BLM; Wyoming Game and Fish Department; University of Wyoming

Off-Road Vehicles

There are several mineral exploration and ranching associated roads located in the project area. These roads are used extensively by persons with four-wheel drive vehicles during the hunting season.

Wilderness Values

There are no roadless areas in or near the proposed project area with identified wilderness values which meet the criteria set in Section 603 of the Federal Lands Policy Act of 1976.

Sightseeing

Most of the sightseeing use in the area can be considered incidental as people travel along State Highway 789.

AGRICULTURE

Livestock Grazing

The Cherokee project area is located in the northwest portion of the Riner grazing allotment and the northeast portion of the Echo Springs grazing allotment. State Highway 789 is the boundary common to both allotments.

The Riner allotment contains 47,499 acres used by one ranch operation which grazes both cattle and sheep. The cattle are grazed during the summer season for a yearly use of approximately 3,350 animal unit months (AUMs). Sheep are grazed during the winter season for a yearly use of approximately 2,382 AUMs. The project area covers 9,411 acres or approximately 20% of the allotment acreage. The planned mining area involves approximately 11% of the allotment acreage.

The Echo Springs allotment contains 64,140 acres used by one ranch operation which grazes both cattle and sheep. The cattle are grazed during the spring and early summer seasons for a yearly use of approximately 7,160 AUMs. Sheep are grazed during the spring, summer, and early fall seasons for a yearly total of approximately 780 AUMs. The project area covers 1,260 acres or approximately 2% of the allotment acreage.

Range improvements on the lease area include approximately 12 miles of allotment boundary fence located on each side of the highway. Three stockwater reservoirs are located within the project area and furnish water for both livestock and wildlife. Other water resources in the area are reservoirs located adjacent to the project area and occasional flows of the intermittent streams in the area.

MINERAL RESOURCES

Coal

The coal seams of interest at this proposed project area are the Upper and Lower Cherokee. The Upper Cherokee seam averages 12 feet in thickness and 7,900 British thermal units per pound (Btu/lb). The Lower Cherokee seam averages 24 feet in thickness and 8,190 Btu/lb. In the southern portion of the mine area, the seams join to form the Cherokee seam that averages 35.5 feet in thickness and 7,850 Btu/lb. The coal is subbituminous B and C in rank.

Inplace reserves are estimated at 250 million tons: Upper Cherokee, 41 million tons; Lower Cherokee, 130 million tons; Cherokee, 79 million tons. A weighted-average analysis of the total coal reserve is: Btu, 8,000; moisture, 21.92%; ash, 14.56%; volatiles, 33.56%; carbon, 29.92%; and sulfur, 1.75%.

Sand and Gravel

Several deposits of sand and gravel occur on and near the project area. Reserves and suitability for use as concrete aggregate are not known (see Map 12 in Appendix A).

Scoria

Several deposits of scoria (clinker) occur within the project area. Reserves and suitability for use as aggregate in railroad spur and road construction are not known.

Oil and Gas

There are existing oil and gas leases within the project area with active exploration in progress.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

A large number of separate governmental agencies exercise certain types of land and resource use controls in Carbon and Sweetwater Counties. The Cherokee project area includes public, state and private lands. The federal sector includes the Bureau of Land Management (public lands and mineral estate under certain private lands). Development, management, use, and control of use on these public lands has been delegated to this agency.

Controls are effected through issuance or nonissuance of a variety of leases, permits, licenses, etc. Each authorization to use public lands contains provisions to control that use. Controls exercised by the federal government for the subsurface estate are governed by the statutes au-

thorizing the disposition and use of that estate. Foremost among these statutes is the authority for leasing coal deposits and authority to require, as a condition of such leases, an operation-management plan and a reclamation-restoration plan. Management policy has been extended in greater detail by the National Environmental Policy Act, of 1969, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. In certain situations, there is a joint or multiagency sharing of particular management and control functions and responsibilities, such as the cooperative agreement between the Department of the Interior and the state of Wyoming that allows the state to administer and enforce reclamation operations on federal leases in Wyoming. The subsurface estate vested in private or state ownership would normally be governed by applicable state of Wyoming statutes.

A number of state agencies have development and administrative authority over state of Wyoming owned lands. Additionally, under state of Wyoming statutes, the state is authorized to perform and administer certain surface land use, planning and development activities on state, county, municipal, and privately-owned properties. Two pieces of legislation passed by the 1975 Wyoming Legislature which could have a significant effect on land use are: The Wyoming State Land Use Planning Act and The Industrial Development Information and Siting Act. The Land Use Planning Act requires completion of county land use plans by 1978, and these plans could conflict with or modify some of the energy proposals. The Industrial Siting Act requires furnishing extensive information and a state permit before certain facilities can be constructed. The impacts of this act would affect developments which include gasification or electric generation proposals. Control does not apply to public properties except as provided by law.

Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands. Certain of these lands were conveyed to the state as part of the Act admitting Wyoming to the Union. This legislation granted Section 16 and 36 of every township to the state for educational purposes. Use and control of these lands (including mineral leasing, rights-of-way, etc.) is governed by Wyoming law. The Cherokee project area includes 640 acres of state lands.

Under Wyoming statutes, counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes. The authority does not apply to any planning or zoning controls over lands used or occupied for the extraction or production of minerals.

Control over mineral uses is vested in the state of Wyoming under the Wyoming Environmental Quality Act of 1973. This act also authorized the state to control air quality, water quality, and solid waste management.

Where a county or city lacks a specific authority, provisions of the Wyoming Joint Powers Act are available to enable joint exercise of power, privilege, or authority. This legislation enables two or more agencies to jointly plan, create, finance, and operate (control) water, sewage, or solid waste facilities; fire protection agency facilities; transportation systems facilities; and public school facilities.

Carbon and Sweetwater Counties have developed and adopted comprehensive plans. Additionally, they have passed zoning ordinances to control land use within their area of jurisdiction.

The Cherokee project in Carbon County, is zoned for ranching, agriculture, and mining; however, there is a scenic highway corridor that extends for a distance of 2,000 feet on both sides of State Highway 789, which traverses the site.

Cities have authority to effect a master plan, zoning, and other regulatory controls. Cities do not have statutory authority to effect controls over mineral extraction or production within their corporate limits. Furthermore, the Wyoming Environmental Quality Act of 1973 would preempt cities; authority to regulate and control air, water, solid waste, and land quality standards except where specifically delegated to a municipality.

In summary, all of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

SOCIOECONOMICS

Demographics

Population

The 1977 population of Carbon County was 18,137. The population of Rawlins was 10,500, while Sinclair was 550 and Wamsutter 347 (Table CH2-5).

Employment

The total employment in Carbon County was 8,067 in 1977 (Table CH2-6). The 1977 unemployment rate for Carbon County was 3%.

Income

The total 1977 personal income (in constant 1977 dollars) in Carbon County was $147.1 million. The major contributors to this income were mining (28.4%), business services (19.7%), consumer services (13.5%), and construction (13.5%). Per capita personal income was $6,348 in 1975. Average weekly wages (Table CH2-7) have been the highest in the mining and manufacturing sectors of the economy.

Table CH2-5

SOUTHCENTRAL WYOMING POPULATION ESTIMTES

Jurisdiction	1977 Population	Percent of Carbon County Population
Carbon County	18,137	100.0
Rawlins	10,500	57.9
Sinclair	550	3.0
Wamsutter (Sweetwater County)	374	--

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, Laramie, March 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

Table CH2-6

EMPLOYMENT BY SECTOR - CARBON COUNTY*

Sector	1977 Employment	Percent of Total
Farm	526	6.5
Manufacturing	360	4.5
Mining	1,658	20.5
Construction	715	8.9
Government	919	11.4
Farm & Forest Processing	46	0.6
Railroads	480	6.0
Business Services	1,415	17.5
Consumer Services	1,948	24.1
Total Employment	8,067	100.0

Note: Employment figures shown represent the number of people living in Carbon County who are employed in one or more jobs. This corresponds to the definition of employment used by the U.S. Bureau of the Census.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, 1978.

Table CH2-7

AVERAGE WEEKLY WAGE BY NON-AGRICULTURAL SECTOR - CARBON COUNTY

Sector	Year 1970	1973	1974	1975	1976	1977*	Average Annual Change (1970-76)**
Manufacturing	161.16	187.81	229.69	264.84	312.96	273.15	11.7
Mining	196.22	233.27	269.67	332.75	377.24	389.94	11.5
Contract Construction	139.55	204.38	221.39	241.05	245.85	255.16	9.9
Wholesale Trade	110.58	126.25	177.75	170.04	182.00	191.58	8.7
Retail Trade	70.08	72.96	93.18	114.21	113.44	115.99	8.4
Finance, Ins. & Real Estate	105.82	122.27	142.29	173.01	175.76	188.81	8.8
Trans., Comm., & Public Utilities	146.31	180.30	188.34	232.06	244.53	258.22	8.9
Services, includ. Agriculture, Forestry & Fisheries	65.40	80.33	86.57	98.96	106.30	124.05	8.4

* Based on monthly data for January 1977 through June 1977.

** This is the average annual rate of change (percent) between 1970 and 1976.

Sources: Wyoming Employment Security Commission, Administrative Services Division, Research and Analysis Section, Casper, Wyoming.

Infrastructure

Private Sector

Total taxable sales in Carbon County were $67.5 million in 1977. Wholesale trade ($7.9 million), retail trade ($46.7 million), and services ($12.9 million) are included in this total.

Local Government

Current (1977) assessed values, mill levies, and bonded indebtedness for the region are shown on Table CH2-8. The bond ceiling, which is the maximum amount of debt that a jurisdiction may incur, is based on the assessed value for the current year. Communities may not issue general revenue bonds for greater than 4% of assessed valuation and sewer bonds for an additional 4%. There is no bond ceiling for water bonds. Counties are limited to 2% of assessed value and school districts are limited to 10%.

Housing

There were 6,160 housing units in Carbon County in 1976, of which 16% were mobile homes. In 1977 there were 3,428 housing units in Rawlins. Of these, 20% were mobile homes (Table CH2-9).

Education

The 1977 school enrollment for District 01 (Rawlins, Sinclair, Baggs, Bairoil) was 2,668. Building capacity in District 01 is 3,368 (Table CH2-10). The expenditures per average daily membership (ADM) was $1,695 for 1976. The statewide average expenditure per ADM was $1,721 (Wyoming Department of Education 1977).

Health Care

In 1977 there were 2,015 people for each physician in Carbon County. The established standard is 1,000 population per physician. The standard for dentist is 1,600 population per dentist, and for registered nurses 285 population per nurse. In Carbon County there were 2,591 people for each dentist and 263 for each registered nurse (Wyoming Department of Health and Social Services 1976, 1978).

Local Services

The Carbon County Sheriff's Office is currently adequately meeting demands and recent increases in workload (drug arrests increased 250% and number of prisoners handled increased 30% in the past year) are not resulting in decreases in the quality of service (Hansen 1978).

A significant proportion of the Carbon County Volunteer Fire Department's equipment dates from the 1940s and 1950s and is in need of replacement. The major inadequacy of this department is its inability to extinguish major fires requiring chemical or foam equipment.

The major problem with the Rawlins Police Department is inadequate facilities. The department is also considered understaffed and staff turnover because of high wages paid to miners adds to personnel problems (DeHerrera 1978).

The largest potential problem in fire protection service in Rawlins is low pressure in the water system, particularly during the summer when demands for water peak. Rawlins' fire protection rating is seven which is considered adequate (Insurance Service Office, Denver, CO).

Current improvements underway on Rawlins' water system are designed to meet water needs of the city until the year 2000 based on current growth rates (Paris 1978).

Rawlins' present sewer system is being improved to correct major inadequacies. These improvements will significantly upgrade the system, however, the system will continue to have problems with old, undersized sewer lines that are overloaded, and with groundwater seeping into older lines (Yamashiro 1978).

Police and fire protection in Sinclair are both considered adequate. Peak water demands can presently be met. A study is underway to determine future needs resulting from potential population growth.

The town of Wamsutter upgraded its water system in the fall of 1977. There is no flow meter on the system, but town officials state that current demand is adequately met with excess capacity. The current lagoon system is working at capacity, but construction to expand the facilities will begin in the fall of 1978. Fire and police services are adequate from the current populations needs.

Transportation and Utilities

Interstate 80, which is one of the principal interstate routes crossing the United States, is the most heavily traveled road in the area.

A major Union Pacific railroad main line passes through southcentral Wyoming. In 1977, freight traffic through Rawlins averaged 50 trains per day carrying a wide variety of products between eastern and western markets.

Amtrak provides passenger railroad service from Rawlins. There is one eastbound and one westbound train daily.

There is an airport in Rawlins. Daily scheduled service is provided by Trans Mountain Airlines. The airport's runway is paved with a length of 5,500 feet.

Interstate bus service is available on a daily basis. The bus depot in Rawlins is served by Continental Trailways, Greyhound, Central Wyoming Transportation, and Zanetti Bus and Fast Express (Russel's Railway and Motor Bus Company Guide 1977).

Carbon County is served by four electric utilities, Pacific Power and Light, Carbon Power and Light, Hot Springs REA, and Yampa Valley Electric.

Table CH2-8

FINANCIAL CHARACTERISTICS
1977

	Assessed Valuation	Mill Levy (per $1,000 assessed valuation)	Bonded Indebtedness
Carbon County	$188,630,804	12.61	$159,100
Rawlins	14,505,124	14.76	2,993,000
Sincliar	4,721,591	8.00	none
Wamsutter (Sweetwater County)	303,480	48.53	198,000

Sources: Assessed Valuation, Mill Levy - Wyoming Taxpayers Association, Wyoming Property Tax Rates, 1977, Cheyenne, August, 1977.

Bonded indebebtedness - community budgets and/or phone conversation with town clerk.

Table CH2-9

HOUSING IN INCORPORATED AREAS
TOTAL AND BY TYPE
1977

County Community	Total Year Round Units	Type of Unit: Single Family	Multiple Family	Mobile Home
Carbon County				
Rawlins	3,428	2,034 (.60)	700 (.20)	694 (.20)
Sinclair	203	198 (.97)	0 (.00)	5 (.03)
Wamsutter (Sweetwater County)	130	64 (.49)	6 (.05)	60 (.46)
Total Housing In Incorporated Areas	5,877	3,357 (.60)	801 (.14)	1,539 (.26)

Note: Figures in parentheses are the fraction of total housing units. These figures may not add to 100 due to rounding.

Source: This data has been taken fron Land Use Plans submitted by the communities to the Carbon County Council of Governments in the fall of 1977. Although the figure on the total housing units in Rawlins was taken from a Land Use Plan, data on the type of housing was estimated from conversations with local officials.

Table CH2-10

PUBLIC SCHOOL CHARACTERISTICS
1977-78

School District School (Grade)	Student Enrollment	Full-Time Equivalent Teachers	Student Teacher Ratio	Building Design Capacity
School District #1				
Mountain View (K-6)	368	18	20.4	460
Pershing (K-6)	282	15	18.8	370
Sunnyside-Central (K-6)	465	14	33.2	488
Baggs-Morrow (K-12)	213	16	13.3	275
Bairoil (K-8)	65	6	10.8	110
Sinclair (K-6)	65	3.5	18.6	140
Rawlins Junior High (7-8)	387	22	17.6	525
Rawlins High (9-12)	823	47	17.5	1,000
Total	2,668	141.5	18.8	3,368

Sources: Wyoming, State of Department of Education, Division of Planning, Evaluation and Information Services, Fall Report of Staff/Teachers/Pupils/Enrollments, 1977, "Statistical Report Series, No. 2," 1977 Cheyenne, Wyoming.

Wyoming State of, Department of Education, Communications Services, Wyoming Education Directory, 1977-78, Cheyenne, Wyoming, 1977.

Telephone conversations with Hugh Simmons, School Superintendent, District #1, March 22, 1978; and John Tynon, School Superintendent, District #2, March 22, 1978.

Northern Gas and Mountain Fuel Supply Company distribute natural gas to the county.

Attitudes and Expectations

The attitudes reflected in this section were derived from the Overland Planning Unit Planning Area Analysis and one opinion survey that has been completed in the Rawlins area.

General Attitudes

A resident survey covering the Overland Planning Unit was done in 1976 by Bickert, Browne, Coddington, and Associates. (The survey is available for review at the Rawlins District Office.) Among other things, residents were asked to rate adequacy of various community services. The results showed that only five services were rated 'very adequate' by 10% or more of the sample. These five were fire protection, schools, utilities, roads and highways, and trash disposal.

Specific Attitudes

The following attitudes were derived from material contained in the Overland Planning Area Analysis:

1. Forest Management: The timber industry, including the Wyoming Wood Producers Association, supports a continued timber sale program: large sales are desired.
2. Access: Hunting and recreation groups strongly support a program to obtain access in checkerboard land areas and other areas where private lands block access to public lands. Groups such as the Carbon County Conservation Club and the Wyoming Game and Fish Department support programs to obtain access.
3. Livestock organizations support a freeze or cutback of grazing fees on public lands. Most operators desire to have increased flexibility with respect to use of grazing allotments, in terms of class of stock, numbers of stock, season of use, etc. Most operators favor predator control and strongly favor management of feral horses and return of feral horse numbers to 1971 levels.

Lifestyles

The ongoing change in the lifestyles of the population residing in the area associated with the Cherokee project are the same as those occurring in the region as a whole. Please refer to the Regional Analysis, Chapter 2, Lifestyles for a complete description of those changes.

FUTURE ENVIRONMENT

In the event that approval was not granted on the mining and reclamation plan nor rights-of-way issued for the ancillary facilities, the Cherokee Mine project would not be developed. In this case, the environment of the project area and immediate vicinity would remain essentially as it is today. Livestock grazing and wildlife habitat would be the primary uses of the area as outlined in the Overland Management Framework Plan land use recommendations of BLM.

The population in those portions of the region that would be impacted by the Cherokee project would increase dramatically even without the project. The population of Carbon County would increase 62% to a total of 29,530 by 1990. Rawlins would increase 90% and Wamsutter 125% by the same time (Centaur 1978). Growth would be limited in Sinclair (4.7%). Employment, income, housing demand, school-age populations, etc., would increase in a like manner through 1990.

Livestock grazing would remain stable. The populations of wildlife species could be increased as shown in the goals of the Wyoming Game and Fish Comprehensive plans. The plans would increase the deer population 4% to 8%, antelope population 15% to 20%, and sage grouse population 50%. The vegetative and soil resource would remain unchanged from present day state.

Recreational activities would increase due to the additional people resulting from the economic growth of the region. Hunting activities would increase significantly due to additional permits and licenses and availability of game.

Archeological sites within the area would remain virtually unchanged except for the surface disturbance caused by casual artifact hunters. The major change in the immediate area would be the improvement of State Highway 789 to accommodate increased traffic and provide greater safety. Population centers would increase in size due to economic growth provided by the development of other resources of the region.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

ASSUMPTIONS AND GUIDELINES

The analysis developed in this chapter is an assessment of impacts resulting from the development of coal on the Cherokee project. Impacts are quantified by time periods of 1985, 1990, and end of mine life. Quantification may be stated as an increment for the time period or as a cumulative total at the end of each time period. The method that best quantifies the impact will be used.

The following narrative and tables were developed to establish assumptions and guidelines for analysis of the proposed mine and reclamation plan for the Cherokee project.

Assumptions

Complete data on reclamation success in the southcentral region are not available. Preliminary success, based on observations of seedings on reclaimed areas less than 4 years old, has been minimal and in some cases a total failure. These minimal results are attributed primarily to climatic conditions (low precipitation, low humidity, strong winds, etc.); also to the method of handling overburden, parting material, and topsoil and the minimal use of seed mixture, contour furrowing, and mulching (Reference Regional, Chapter 2, Vegetation).

Based on field observations of other reclaimed areas such as roadside cuts and fills, barrow areas, etc., it is estimated that reclamation would occur as outlined in items 2 and 3 that follow, assuming that all mitigating measures as proposed in the reclamation plan would be applied. The mitigating measures outlined in the reclamation plan are proposed under the regulations that existed prior to SMCRA. The reclamation success anticipated with the application of the SMCRA regulations is discussed in Chapter 4.

Guidelines

1. Impacts are analyzed for three time points (1985, 1990, and end of mine life—2024).

2. Preliminary reclamation on an area is considered complete when disturbed lands have been backfilled, graded, contoured, and seeded.

Complete reclamation of an area will require an average of 7½ years or more; 3 years for filling, shaping, contouring, seedbed preparation, and seeding; 4½ or more years (up to 10 to 15 years) for establishment of vegetative cover in accordance with an approved mining and reclamation plan.

3. Reclamation of land as proposed in the reclamation plan would take place in the following sequence and result in vegetation suitable for cattle grazing:

1st year—shaping (filling and contouring)
2nd year—reshaping and topsoiling
3rd year—seedbed preparation and seeding (fall)
4th year—rest for seedling establishment
5th year—rest for plant vigor, and reseeding of failure areas
6th year—rest for plant vigor, and seedling establishment
h year—rest for plant vigor
8th year—defer first half of grazing season

The following tables are presented to provide an overview of total land disturbance that would occur due to development of the Cherokee project. Table CH3-1 portrays the acres of land disturbed and reclaimed during each designated time period by various activities related to the project, and Table CH3-2 portrays the disturbance and reclamation of the same acreage as cumulative total for each time period by activities. Table CH3-3 presents a summary of impacts, and it is noted whether or not they exceed the allowances set in the Surface Mining Control and Reclamation Act of 1977 (SMCRA).

AIR QUALITY

Emissions from the Proposed Mine

Mining activities at the proposed Cherokee Mine site would generate certain quantities of fugitive dust emissions. As a result, it is likely there would be a change in the total suspended particulate (TSP) concentration at the mine site and in surrounding areas. In order to determine the magnitude of such changes, it is necessary to identify the sources of fugitive dust emissions at the mine site, quantify the emissions from each source, locate the source within the proposed mining activity, and subsequently interpret the resultant air quality.

Eleven major sources of fugitive dust would be associated with the proposed facility: haul road traffic, shovel/truck loading, dragline, blasting, drilling, truck dump, topsoil removal, front-end loading, access road traffic, open storage of coal prior to washing, and wind erosion from exposed areas. Two point sources would be coal crushing and train loading. Table CH3-4 lists these emis-

Table CH3-1

ACREAGE DISTURBED BY ACTIVITY AND ACREAGE RECLAIMED
OVER PERIODS OF TIME
(NONCUMULATIVE)

Activity	Time Periods			Total
	1985	1990	1990+*	
Final Contour	1,131	1,337	5,155	7,623
Mine Facilities	236			236
Ancillary Facilities	381			381
Relocations	26	180		206
Subtotal	1,774	1,517	5,155	8,446
Population	249			249
Total	2,023	1,517	5,155	8,695
Acres Reclaimed	--	570	7,675	8,245

*To end of mine life which is estimated to ~~be~~ 2024

Table CH3-2

ACREAGE DISTURBED BY ACTIVITY AND ACREAGE RECLAIMED
OVER PERIODS OF TIME
(CUMULATIVE)

Activity	Time Periods		
	1985	1990	1990+*
Final Contour	1,131	2,468	7,623
Mine Facilities	236	236	236
Ancillary Facilities	381	381	381
Relocations	26	206	206
Subtotal	1,774	3,291	8,446
Population	249	249	249
Total	2,023	3,540	8,695
Acreage Reclaimed	--	570	8,245

*To end of mine life which is estimated to be 2024.

Table CH3-3

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceed Allowances of SMCRA Regulations
Climate	None	N/A
Air Quality		
AQ-1	Generation of fugitve emissions would cause an increase in TSP concentrations at the mine site and closely surrounding areas	N/A
AQ-2	Increased TSP would somewhat reduce visibility at and near the mine	No
AQ-3	Slight amounts of NO_2, SO_2, and HC would be generated by mine vehicles	No
Geology		
Paleontology		
GE-1	Loss of paleontological resources	N/A
Topography		
TO-1	Alteration of existing features and drainages	Yes - 30 CFR 715.14
Soils		
SO-1	Destruction of established soil profiles on 8,695 acres	N/A
SO-2	Loss of soil productivity on 8,696 acres	No - 30 CFR 715.16
SO-3	Increased soil loss by wind (0.42 ton/acre-year) and water (2.5-4.5 ton/acre-year) erosion on unprotected areas (8,245 acres)	Yes - 30 CFR 715.13 30 CFR 715.14 30 CFR 715.16
SO-4	Fugitive dust (soil loss) from mining activities	N/A
SO-5	Increased wind and water erosion on topsoil stockpiles and overburden spoil piles	Yes - 30 CFR 715.14 30 CFR 715.16c 30 CFR 715.16(a) 1
SO-6	Contamination of soil around mine facilities	Yes - 30 CFR 715.14(j)
SO-7	Alteration of topography, slopes, and drainage patterns, resulting in increased erosion	Yes - 30 CFR 715.14 30 CFR 715.14
SO-8	Exposure of material toxic to revegetation	Yes-30 CFR 715.14(j)
Water Resources		
WR-1	A 0.4% increase in water use	N/A
WR-2	Lowered water table	No - 30 CFR 715.17

Table CH3-3
(Continued)

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
WR-3	Destruction of two or three stock reservoirs	No - 30 CFR 715.17
WR-4	Possible contamination of groundwater at Cow Butte Basin	Yes - 30 CFR 715.17
	Where?	
Vegetation		
VG-1	Loss of vegetative cover on 8,446 acres until reclaimed	N/A
VG-2	Reclamation by seeding method would result in longer time period to establish shrub species	Yes - 30 CFR 715.13(a) 30 CFR 715.20(a)(1)
VG-3	Grazing of young plants on reclaimed areas would delay establishment of vegetative cover.	Yes - 30 CFR 715.13(a)
VG-4	Control of haul road dust and fugitive coal dust that could reduce palatability of vegetation for mine life would be 50% effective	N/A
VG-5	Noxious weeds could invade onto the disturbed and reclaimed areas	N/A
VG-6	Loss of native vegetative cover on 249 acres utilized in housing and support service sites	N/A
Fish and Wildlife		
WL-1	Direct loss of 8,446 acres of wildlife habitat until reclaimed	N/A
1a	Loss of 3,200 pronghorns on 8,446 acres until reclaimed	
1b	Loss of 11,143 sage grouse on 10,586 (includes "zone of infuence") acres until reclaimed	
Cultural Resources		
CR-1	Possible destruction of subsurface archeological sites	N/A
Visual Resources		
VR-1	Destruction of existing landscape	N/A
Recreation Resources		
RE-1	Loss of recreation visitor days - especially hunting	N/A

Table CH3-3
(Continued)

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Agriculture		
AG-1	Loss of suitability of range for sheep grazing on 8,695 acres for 40 years	Yes - 30 CFR 715.13(a) 30 CFR 715.20(a)(1)
1a	Loss of 40,140 animal unit months of grazing during mining and reclamation	
AG-2	Destruction of thee stockwater reservoirs	Yes - 30 CFR 715.13(a) 30 CFR 715.13(9)
Mineral Resources		
MR-1	Loss of mineral resources (coal, sand, gravel, scoria) through mining and mine-related uses	N/A
Land Use Plans		
LU-1	Surface mining within a zoned scenic corridor	N/A
Socioeconomics		
SE-1	Increased employment opportunities	N/A
SE-2	Competition for available labor force among competing sectors of the economy	N/A
SE-3	Increase in total wage earnings	N/A
SE-4	Create local inflationary pressures reducing buying power on people on fixed incomes	N/A
SE-5	Increased wholesale and retail sales	N/A
SE-6	Overcrowded housing conditions	N/A
SE-7	People occupying housing not up to their desires or needs	N/A
SE-8	Worsened population/health care specialist ratios	N/A
SE-9	Work-related injuries or illness	N/A
SE-10	Work-related facilities or debilitating injuries	N/A
SE-11	Increased pressures on local services	N/A
SE-12	Traffic delay at railroad crossings	N/A
SE-13	Air and noise pollution	N/A
SE-14	Congestion on access roads	N/A

*N/A--Not Applicable, that is, no provisions of SMCRA apply to the specific impact

Table CH3-4

FUGITIVE AND POINT SOURCES IDENTIFIED AT THE PROPOSED FACILITY WITH CORRESPONDING EMISSION FACTORS*

Emission Source	Emission Factor
FUGITIVE:	
1. Haul roads (with watering)	13.6 lb/vehicle-mile traveled
2. Shovel/truck loading - coal	.007 lb/ton loaded
3. Dragline - overburden	.053 lb/ton removed
4. Blasting	
a. Coal	72.4 lb/blast
b. Overburden	85.3 lb/blast
5. Drilling	
a. Coal	.22 lb/hole drilled
b. Overburden	1.5 lb/hole drilled
6. Truck dumping - coal	0.20 lb/ton dumped
7. Topsoil removal	
a. Scraping	.35 lb/ton scraped
b. Dumping	.03 lb/ton dumped
8. Front-end loading	.12 lb/ton loaded
9. Access road traffic	5.11 lb/vehicle-mile traveled**
10. Exposed area	.42 lb/acre-year***
11. Coal storage	8.64 lb/acre/hr
POINT SOURCES:	
1. Coal crushing	.01 lb/ton crushed
2. Train loading	.0002 lb/ton loaded

*Emission factors from PEDCo Environmental, Inc., 1978, except as noted.

**Calculated from formula in U.S. Environmental Protection Agency 1975.

***Calculated from formula in Midwest Research Institute 1974.

sions sources and the corresponding emission factors. The annual emissions from the proposed site were calculated using the emission factors listed in the table. The operational parameters were obtained from the mining and reclamation plan, Chapter 1 of the environmental statement, and personal communications with mining company personnel.

Emission inventories were performed for the mining years of 1985, 1990, and 2020 which would be the last active year of mining. These inventories are the best approximations of the complex interaction of variables. Table CH3-5 presents the annual emissions from each source for the designated years.

Best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plans on file with GS in December, 1977 were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. Chapter 8 contains air quality alternative which discusses the best management practice impacts.

The gaseous air pollution sources would be exhaust emissions from diesel-powered haul trucks and employees' motor vehicles. Emission factors for vehicular travel were obtained from EPA's most recent compilation of mobile source emission factors and reflect current legislation relative to future emission standards in high altitude areas (EPA 1978).

Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur oxide (SO_x) are shown in Table CH3-5A. These emissions would occur from both employee travel on the mine site and haul trucks. Emission rates per mile of travel between 1985 and subsequent study years will decrease. In the case of Cherokee, these reduced emission rates partially offset increased production rates in 1990. The emissions of gaseous pollutants would not result in significant ambient concentrations on or near the proposed mine site.

Impact on Air Quality

The impact of the annual emissions listed in Table CH3-5 on the nearby ambient TSP concentrations was determined by use of the Modified Climatological Dispersion Model-Version 3 (MCDM-V3) (PEDCo Environmental, Inc. 1976). The model performs both annual averaging and worst case 24 hour periods. Data input consists of the following: source locations; source emission rates; emission heights; locations where ground-level pollutant concentrations are desired; and frequency of occurrence of each of 16 wind directions, 6 wind speeds, and 6 stability classes.

MCDM determines long and short-term quasi-stable pollutant concentrations at any ground-level receptor using average emission rates from point and area sources and a joint frequency distribution of wind direction, wind speed, and stability for the same period. Climatological input data are in the form of a Stability Rose (STAR) deck. The STAR deck used for modeling the proposed action was generated from data collected at the Rawlins, Wyoming weather station. Also included in the program were particulate fallout functions which account for the relatively large size of particles generated from the mining activities. An explanation of these factors and their development is described by PEDCo Environmental, Inc. 1978.

Maps CH3-1 through CH3-3 show the annual predicted and resulting ambient TSP concentrations for the years 1985, 1990, and 2020, as determined by the model. Maps CH3-4 through CH3-6 show the worst case 24-hour predicted and resulting ambient TSP concentrations for the same years. Concentrations in both situations are shown to decrease rapidly with distance.

In general, Maps CH3-1 and CH3-2 for the years 1985 and 1990 show no violations beyond the mine border of the Wyoming annual particulate standard of 60 micrograms per cubic meter ($\mu g/m^3$). However, in the northeast corner and along the northern sections of the eastern boundary, TSP concentrations would approach or slightly exceed the annual standard. The area in violation would lie no more than 1.2 miles from the project boundary. As shown in Maps CH3-4 and CH3-5, a few violations of the Wyoming 24-hour standard are also predicted for this corridor.

The year 2020 would be the final year of coal production at the Cherokee Mine. Map CH3-3 shows violations of the annual standard are again expected along the northeastern and eastern boundaries at a maximum distance of 1.2 miles from the project border. Violations of the 24-hour standard may also be exceeded along the eastern boundary of the project area at a distance of 0.6 to 1.2 miles.

Note that under the new PSD regulations (43 CFR 118), these violations do not occur. In fact, the surface mines are well within the applicable NAAQS and PSD regulations.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed facility. Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants carbon monoxide (CO), hydrocarbons (HC), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). Predicted concentrations of these pollutants were not modeled due to the lack of detailed data on vehicle use and applicable background data. However, recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines estimate the probable range of impact to be insignificant. Assuming similar vehicle activity for the proposed mine, ambient concentrations of gaseous pollutants would be minimal and insignificant compared to their respective standards.

Table CH3-5

ANNUAL EMISSIONS FROM EACH MAJOR SOURCE FOR EACH STUDY YEAR

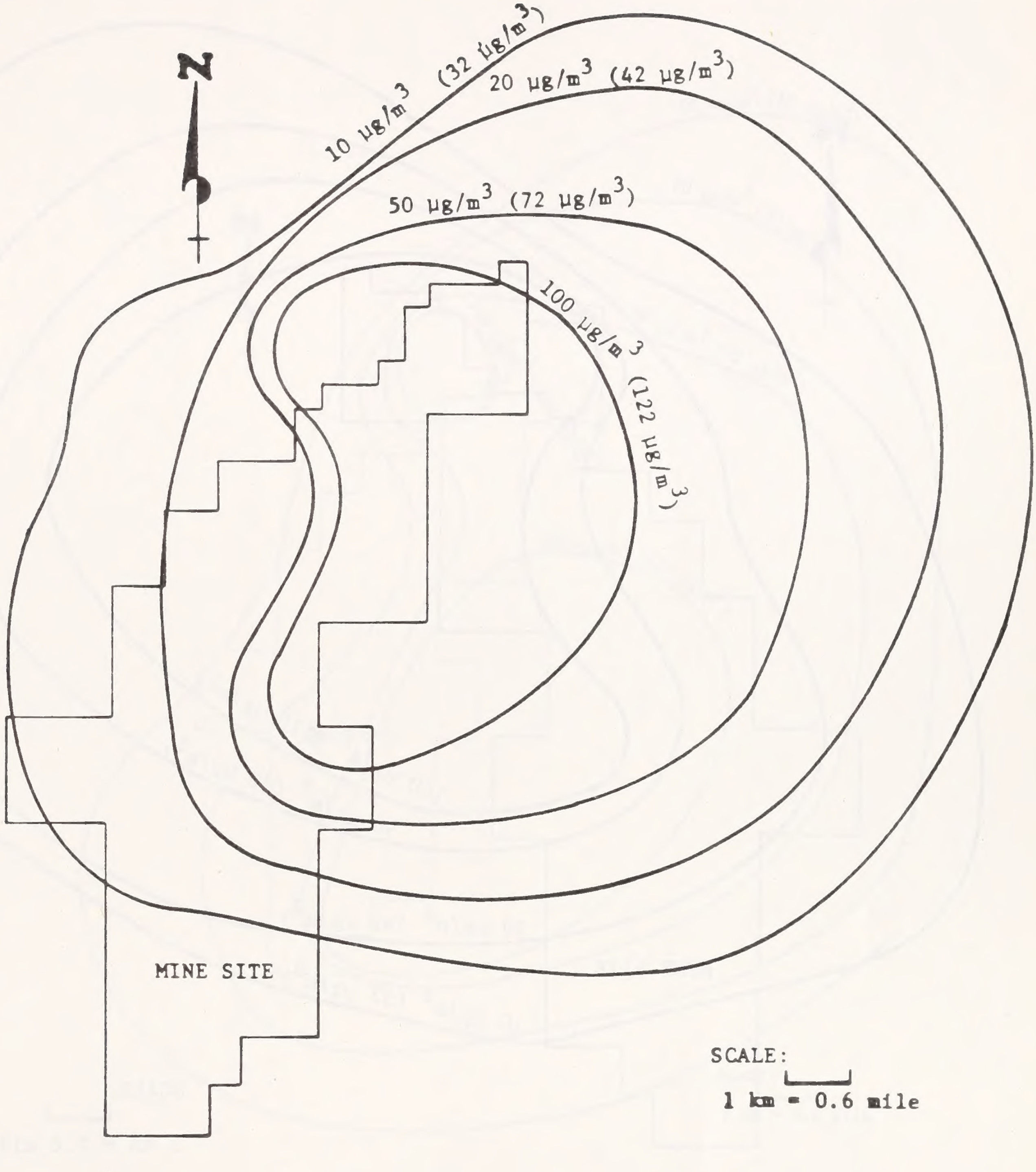
EMISSION SOURCE	TONS PER YEAR		
	1985	1990	2020*
1. Haul roads	1,032	2,992	3,196
2. Shovel/truck loading - coal	11	19	19
3. Dragline - overburden	246	421	421
4. Blasting	20	20	20
5. Drilling	12	12	12
6. Truck dumping	35	60	60
7. Topsoil removal	217	217	0
8. Front-end loader	21	36	36
9. Access road traffic	1,941	1,141	1,141
10. Exposed area	437	447	449
11. Open storage	50	87	87
12. Train loading	<1	<1	<1
13. Coal crushing	9	15	15
Total	4,032	5,468	5,457

* Last year of active mining.

Table CH3- 5a

EMISSIONS OF GASEOUS POLLUTANTS FROM VEHICLES AT THE PROPOSED CHEROKEE MINE SITE

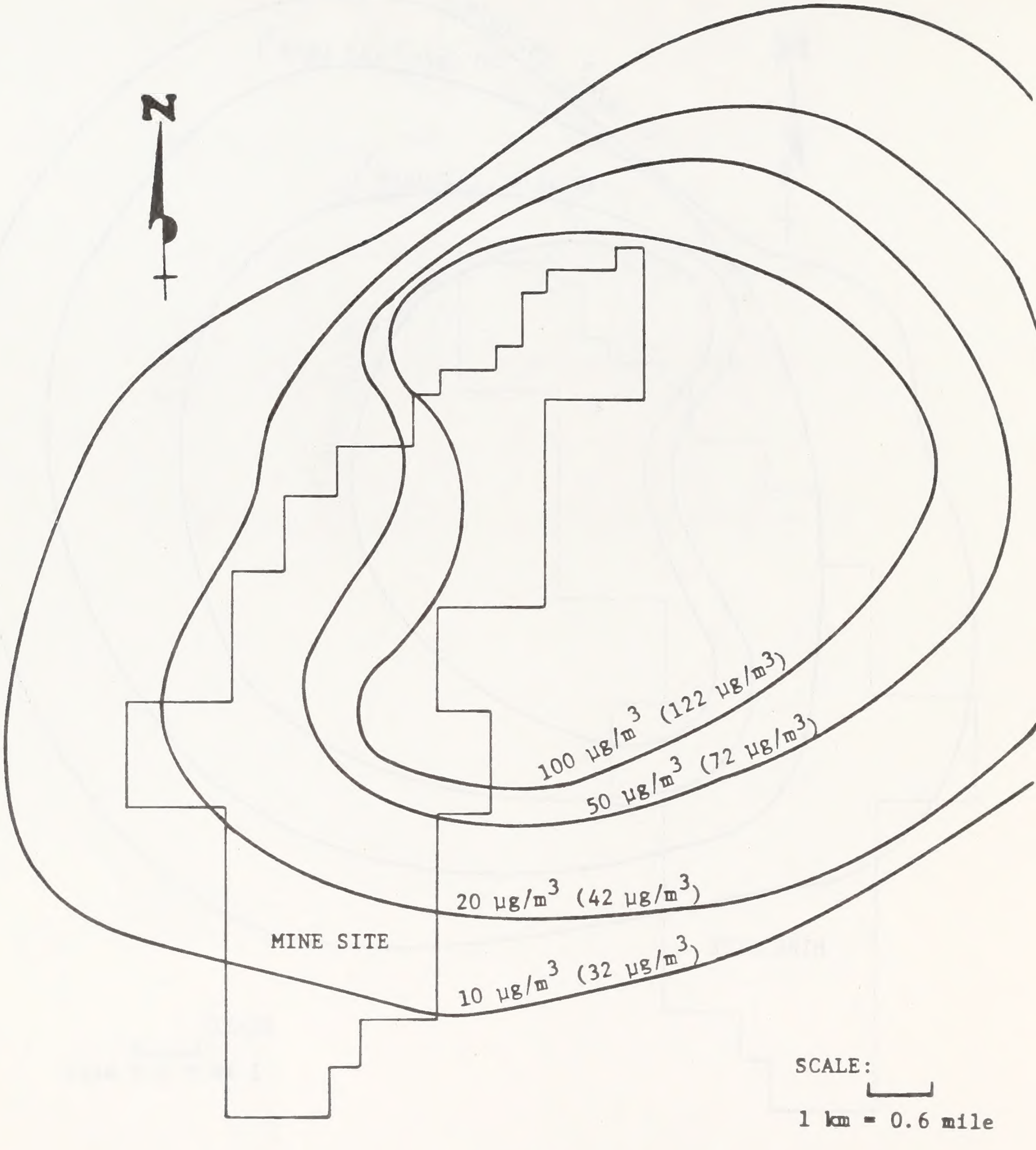
Year	Total annual emissions, tons/yr			
	CO	HC	NO_x	SO_x
1985	16.0	1.6	3.5	0.5
1990	11.8	1.3	3.2	1.4
2020	12.5	1.4	3.4	1.5



MAP CH3-1

ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1985 AT THE PROPOSED CHEROKEE MINE SITE.*

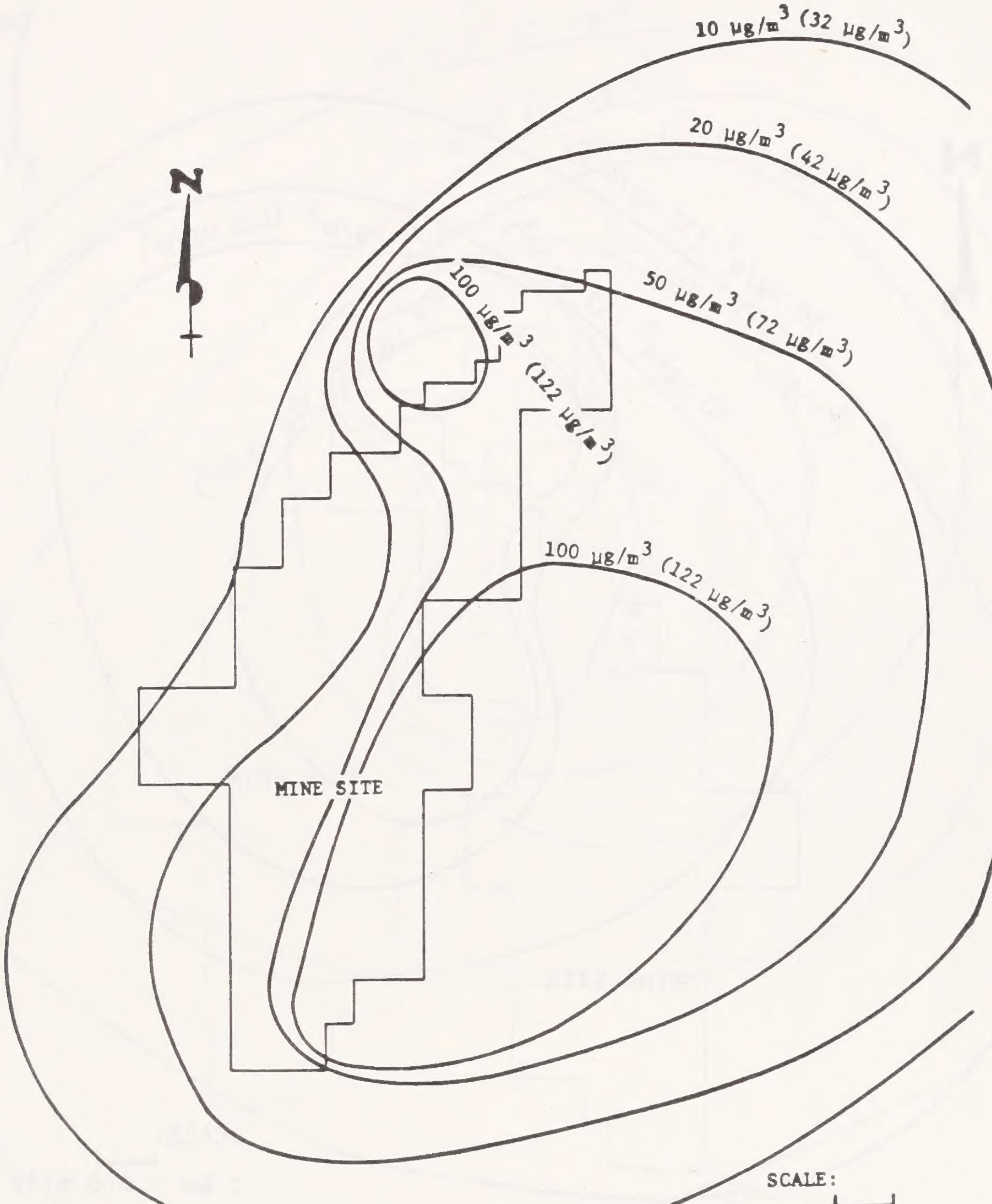
*Resulting ambient concentration is in parentheses.



MAP CH3-2

ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1990 AT THE PROPOSED CHEROKEE MINE SITE.*

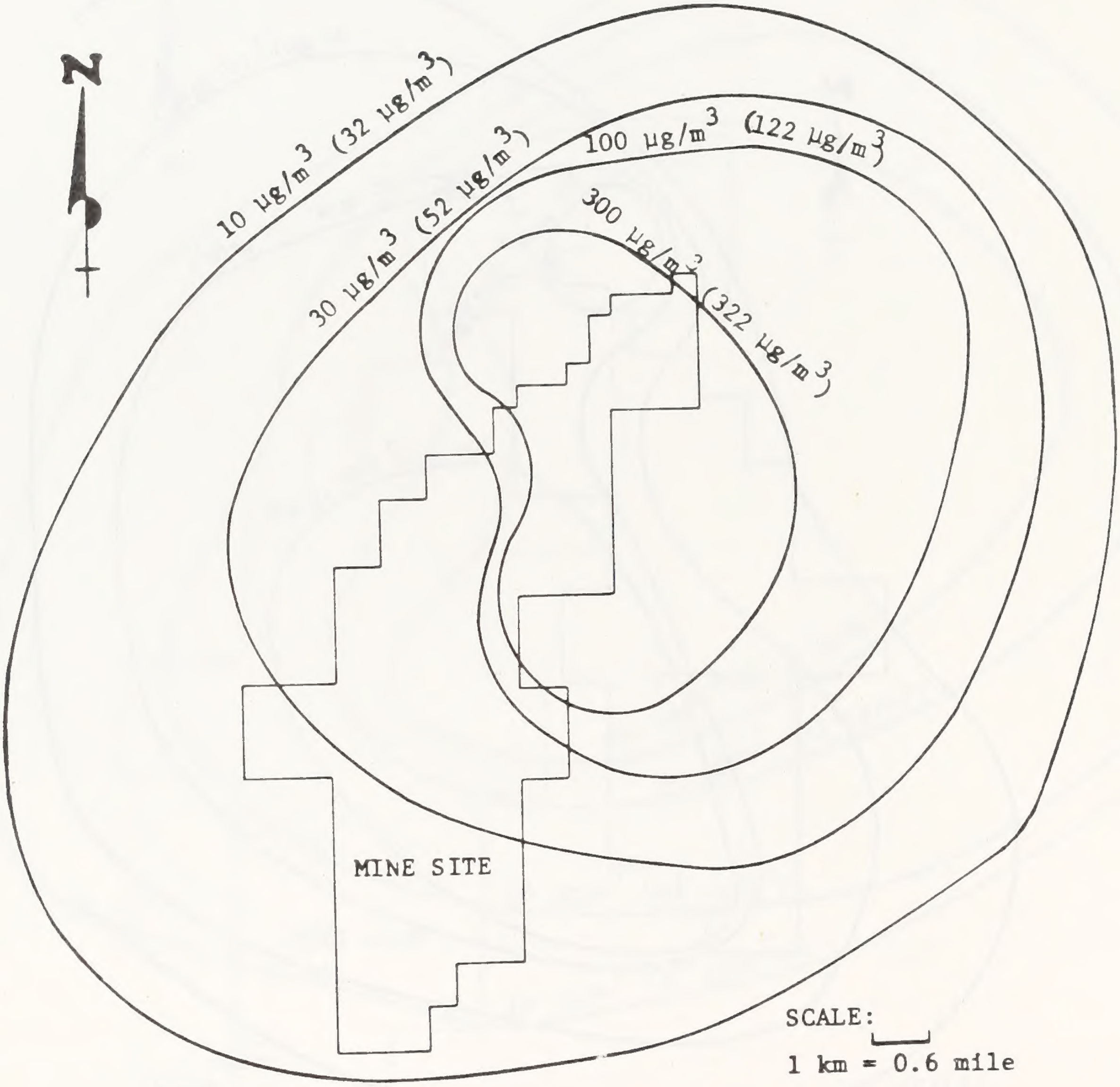
*Resulting ambient concentration is in parentheses.



MAP CH3-3

ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 2020 AT THE PROPOSED CHEROKEE MINE SITE.*

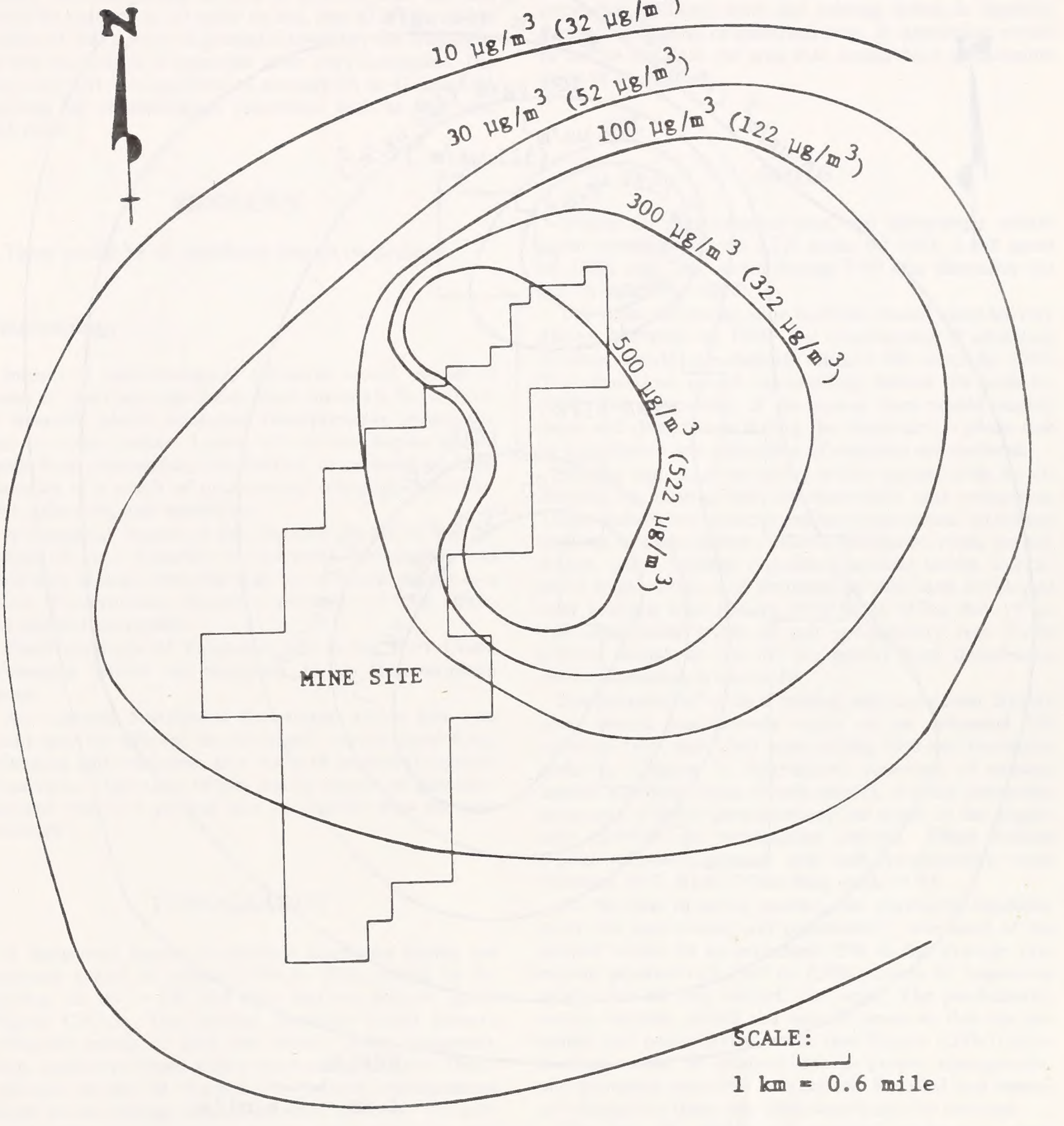
* Resulting ambient concentration is in parentheses.



MAP CH3-4

ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1985 AT THE PROPOSED CHEROKEE MINE SITE.*

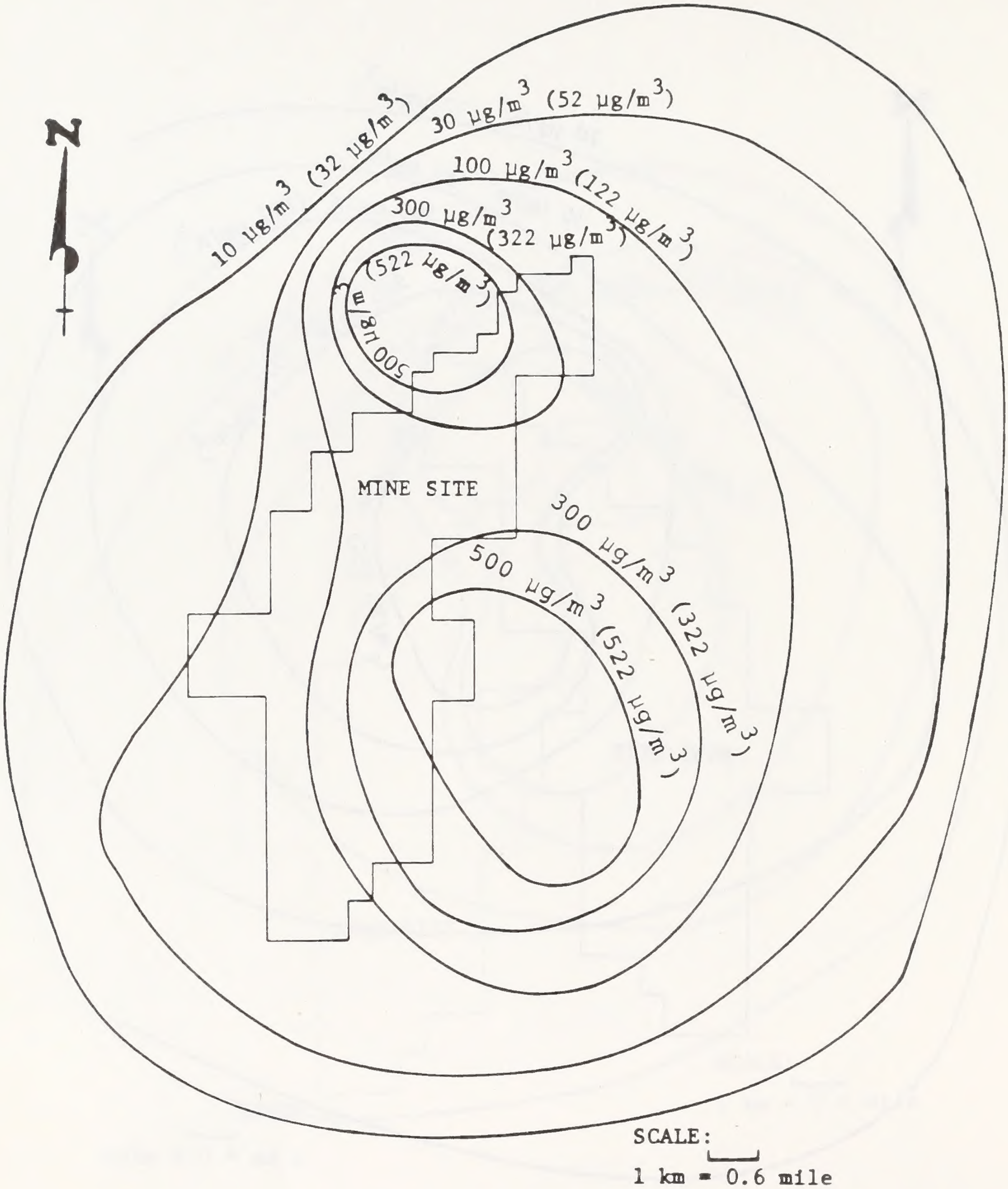
*Resulting ambient concentration is in parentheses.



MAP CH3-5

ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1990 AT THE PROPOSED CHEROKEE MINE SITE.*

*Resulting ambient concentration is in parentheses.



MAP CH3-6

ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 2020 AT THE PROPOSED CHEROKEE MINE SITE.*

*Resulting ambient concentration is in parentheses.

Visibility

The addition of particulates to the atmosphere would reduce visibility in the area. It is possible that visibility could be reduced to 13 miles or less, due to TSP concentration of 160 $\mu g/m^3$ or greater. However, the frequency of this occurrence is expected to be very infrequent. For the most part it is expected to average 26 to 47 miles depending on climatological conditions such as fog, rain, and snow.

GEOLOGY

There would be no significant impact on geology.

Paleontology

Impact to paleontological resources would consist of losses of plant and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses of various degree would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

Fossil materials of Paleocene age in the Fort Union Formation would be impacted to an undetermined extent.

All exposed fossilferous formations within the area could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased regional population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

TOPOGRAPHY

A temporary impact on existing landforms during the proposed period of mining (1984 to 2024) would be the moving cut up to 150 feet deep and the piles of spoils (Figure CH1-3). The cutting operation could remove prominent points of land and would create temporary steep, unnatural slopes where none existed before. Minor drainages would be blocked by roadbed embankments which would change natural drainage patterns. The proposed railroad spur would require numerous cuts and fills to maintain grade along Fillmore Creek and the numerous points of land and re-entrants east of the creek. Drainage ditches would create new topographic forms and shapes. Removal of clinker and gravel for road construction would alter topography. A delta of tailings would build up in the southwest quadrant of the playa to be used as a tailings disposal area. This would not occur if the alternate plan was initiated. This plan would provide for dewatering the fine reject in the plant and burying the waste in the pits. The net effect after reclamation would be a gently rolling topography similar to, but somewhat different from the existing forms in approximately 7,600 acres of disturbed area. A depression would be left in the final cut area that would have a maximum slope of 16 degrees.

Where? Cow Butte Basin

SOILS

Within the final contour area, soil disturbance would occur cumulatively on 1,131 acres by 1985; 2,468 acres by 1990; and 7,623 acres during 1990 and thereafter (to end of mine life—2024).

The construction of mine facilities would cumulatively disturb 236 acres by 1985. The construction of ancilliary facilities would cumulatively disturb 381 acres by 1985. The relocations would cumulatively disturb 206 acres by 1990. The relocations of the power lines would mainly cause soil disturbance during the construction phase due to compaction and disruption of sensitive soil surfaces.

Mining and other activities would impact soils by alteration of existing soil characteristics and properties. These include soil microorganism composition, structure, textures, organic matter content, infiltration rates, permeability, water holding capacities, nutrient levels, soil-climatic relationships, and productivity that have developed over geologic time (Brady 1974; BLM 1976e; Bay 1976). The established levels of soil productivity (see Table CH3-6) would be lost for the period from disturbance until reclamation is successful.

Reclamation of surface mining and associated facility areas would cumulatively occur on an estimated 570 acres by 1990; and 8,245 acres during 1990 and thereafter (refer to Chapter 3, Vegetation). Amounts of suitable topsoil material, steep slopes, aspect, surface manipulations, and climate (precipitation) are some of the important variables of reclamation success. These factors would influence erosion and soil productivity rates (Monsen 1975; BLM 1976e; May et al. 1971).

At the time of initial seeding and vegetative establishment, the post-mining soil productivity over most of the project would be an estimated 75% of the average pre-mining productivity (500 to 1,200 pounds of vegetative production air dry weight, per acre). The productivity would increase during the next 40 years so that the potential soil productivity levels (see Figure CH3-1) (pre-mining) would be attained due to proper management, and increased microbial interactions. Physical and chemical changes in these new soils would also be initiated.

The lack of suitable soil material, moderately steep slopes, and areas poor for reclamation are evident on the Cherokee project in mapping units 401, 237, and 245 (refer to Chapter 2, Soils). The disturbance of these soils would lead to improvement of soil productivity on approximately 909 acres, since soil depths would increase on unit 401, and subsoil salts in units 237 and 245 would be buried. Also, the slopes would be lessened, thereby

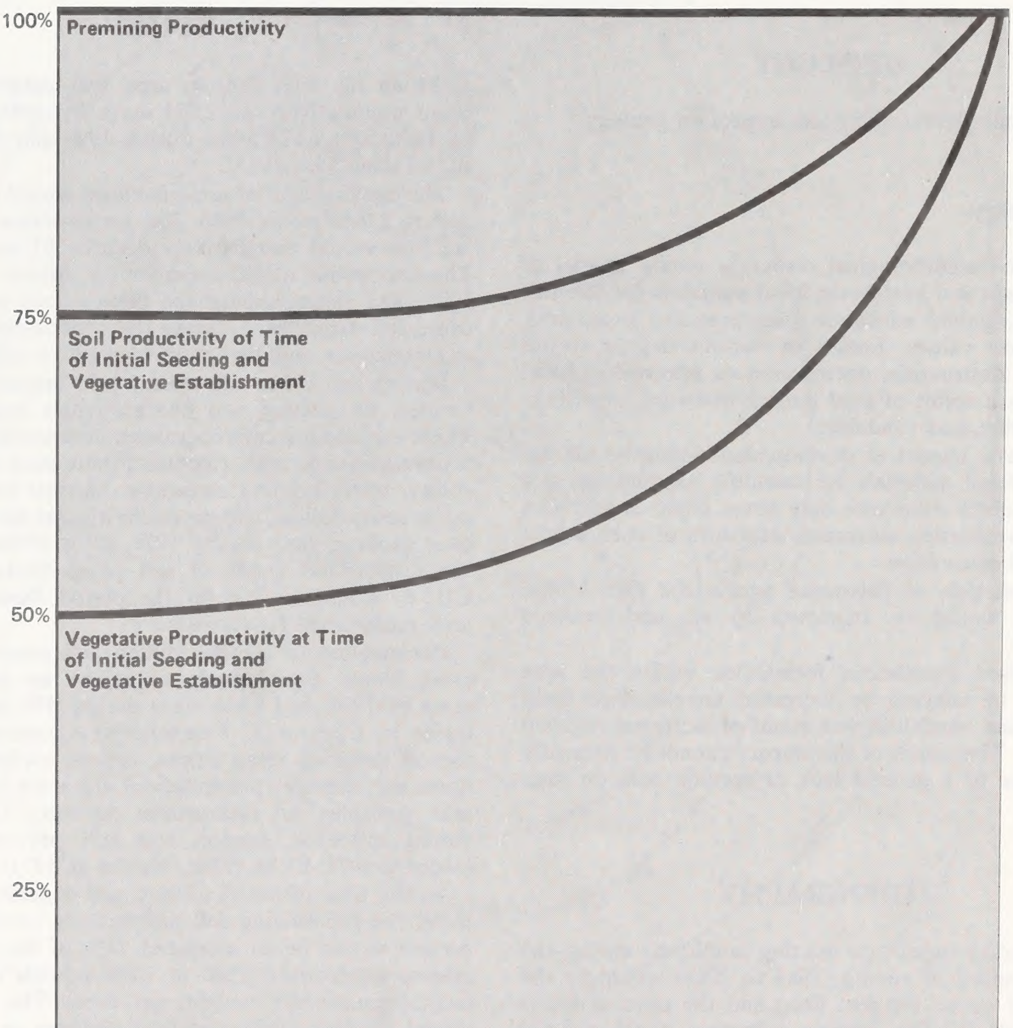


Figure CH 3-1

SOIL AND VEGETATIVE PRODUCTIVITY UNDER THE PROPOSED ACTION
Cherokee

Table CH 3-6

SOIL PRODUCTIVITY AND ACRES DISTURBED

Mapping* Unit	Soil Associations**	Acres***	Soil**** Productivity
37A	Fleutsch (85%)	102	595-1,020
202	Tasselman (50%) Shinbara (25%)	---	413-562
207	Delphill (40%) Blazon (30%)	141	470-675
210	Ravalli (30%) Forelle (30%) #15 (25%)	---	475-735
225	Cushool (50%) Rock River (30%)	1,920	497-960
231	Rock Rim (40%) Cushool (25%) Ryark (15%)	595	560-960
232	Blazon (50%) Delphill (15%) Diamondville (15%)	122	475-738
234	Rock River (35%) Ryark (25%) Cushool (15%)	13	525-900
235	Blazon (45%) Shinbara (30%)	64	300-473
236	Cushool (35%) Worfamn (20%) Blackhall (20%)	352	455-700
237	Seaverson (40%) Blazon (30%)	314	310-465
238	Blanyon (35%) Bulkley (25%) Lisam (30%)	45	510-885
241	Diamondville (40%) Blazon (20%) Forelle (20%)	160	480-780
242	Blackhall (50%) Blazon (30%)	83	325-475
245	Abston (30%) Rallod (25%) Seaverson (20%)	352	385-638
246	Cushool (35%) Rallod (30%) Blazon (20%)	621	475-805
247	Cushool (40%) Diamondville (25%) Worfman (20%)	1,337	595-960
248	Cothren (50%) Crestman (30%)	---	660-970
249	Absher (50%) Abston (30%)	---	380-600
250	Rock River (85%)	986	595-1,020
320	Monte (50%) Clowers (25%)	173	900-1,300
401	Rockland Land Type (70%)	243	---

*Map reference numbers refer to Soils Map CH2-1

**Soil Series and percent making up soil associations: minor soils comprising a part of a soil association are not listed in this table; therefore, the composition does not total 100% for each soil association.

***Acres disturbed by soil association in final contour acreage.

****Soil productivity of soil associations (pounds air dry weight vegetative production per acre per year--SCS production data). Additional minor soils in each association not included in calculations.

Sources: U. S. Department of Agriculture, SCS 1976, 1978, and MRC 1976c.

lowering erosion hazards on the new soils created by reclamation. Total available soil material for reclamation is more than adequate on the Cherokee site (refer to Chapter 2, Soils).

Mining could expose material which contains chemical constituents (such as selenium, boron, or uranium) that would be harmful to plants and animals. These materials could exist in the overburden material of the Fort Union Formation (see Geology and Water Resources). Overburden found in the area containing material with high alkalinity (SAR) or salinity (E.C.); low or high pH; sand or clay textured material; and material with low cation exchange capacities would hamper reclamation (BLM 1976e). The lack of any overburden analysis in the mining and reclamation plan precludes any specific impact analysis of overburden suitability for reclamation. The Red Rim Soil Survey (USDA, SCS 1976), an unpublished SCS soil survey 1978, and additional survey data (MRC 1976c) over the Cherokee area show moderate to high accumulations of alkalinity and/or salinity in soils of mapping units 237, 245, and portions of 320.

The exposure, compaction, burial, stockpiling (233 acres), disturbance, and contamination of surface soil would cause reductions in the current levels of soil productivity and increase soil loss from wind and water erosion. Stockpiling surface soil would degrade biological, chemical, and physical properties, causing temporary reductions in productivity when used in reclamation (Monsen 1975; BLM 1976e; Singleton and Cline 1976). Accidental spills of oil, gasoline, and other toxic materials could contaminate surface soils, especially around mine facilities. This spillage would contaminate and sterilize the soil horizons, rendering the affected soil permanently unusable for reclamation.

All of the mining disturbances would result in accelerated erosion by wind and water upon presently existing soils, stockpiled soil material, and overburden storage areas due to exposure and increased activity (Monsen 1975). Mining activities would also increase soil loss from increased fugitive dust levels, especially from haul roads and access road (see Air Quality, Table CH3-5). Wind action, which is fairly constant over the area, would cause fine particles to be lifted from the exposed surfaces and blown away. Wind erosion from the exposed areas (before revegetation) would be an estimated 0.42 tons/acre/year (see Air Quality, Table CH3-4). Prior to revegetation of exposed, disturbed, and stockpiled soils, high intensity storms (possibly occurring about 1 year in 10, to 1 year in 25 years) occurring mainly in late May or June could lead to increased water erosion (Lowham 1976; Becker and Alyea 1964). The increased erosion would result from the disturbed soils not having any protective cover and a reduction of soil infiltration rates (resulting from compaction and steep slopes) causing increased runoff (Dollhopf et al. 1977). The erosional rates over the final contour areas prior to revegetation would be an estimated 2.0 to 4.5 tons/acre/year.

Alterations of soil due to mining, culverts, impoundments, diversions, drainage ditches, channeling, and changes in topography could increase flow velocities from unprotected soils, accelerating sheet and rill or gully erosion (see Water Resources, Chapter 3). An area of concern would be the Fillmore Creek drainage where the proposed rail spur would disturb soils in mapping unit 320. The use of a saline-alkali flat as the tailing disposal area would cause minimal disturbance to soils, except for the wind erosion. No disturbance of this flat would occur under the alternate plan to dewater the fine reject in the plant and bury the waste (see Wildlife Alternative, Chapter 8).

Mine-related population increases and their associated support facilities would cumulatively remove from productivity 249 acres by 1985. Additional loss is not anticipated after 1985 (refer to Table CH3-2).

All developments (final contour, mine facilities, ancilliary facilities, relocations, and population increases) would cumulatively disturb soils on 2,023 acres by 1985; 3,540 acres by 1990; and 8,695 acres by the end of mine life (2024). The disturbance on 8,245 acres would be of a temporary nature since reclamation would eventually be accomplished. The loss of soil productivity would be permanent on 450 acres by end of mine life. The 7,859 acres disturbed within final contour and by mine facilities would be approximately 73.6% of the project area.

WATER RESOURCES

Groundwater

Mining would progress from land surface at the east edge of the property to a depth of about 150 feet at the west edge. A high mound in the groundwater table, that results from upward movement, would be reached at depths ranging from 60 to 90 feet. Prior to reaching the water table, during a period of up to 10 years, the mine pits would intercept almost no groundwater.

After mining has proceeded below the water table, water could drain into the mine pits at a rate of 1 to 4 gallons per day (gpd) per foot of mine pit. Total flow into the mine probably would be less than 12,000 (gpd). Artesian aquifers would not be intercepted, but reducing the thickness of rock material overlying these aquifers could allow slightly greater amounts of water to move upward than does under existing conditions. Pressures in the artesian systems are not great enough to cause buckling or cracking of mine floors, and there is no potential for poor quality water from the upper aquifers to contaminate deeper aquifers. No impact is foreseen even if buckling did occur.

Water would enter the mine through upward movement, or from dewatering of sandstones in a very localized area; therefore, the mine pits should have little if any, impact on surrounding water levels.

Mine drainage would be used for dust control, but the drainage would not be sufficient to meet mine needs and additional water would be required for dust control and washing coal. From 500 to 600 acre feet per year (ac ft/yr) would be withdrawn from the basal sandstone of the Fort Union Formation at a rate of 370 to 400 gallons per minute. This would probably be less than 1% of the

amount stored in the aquifers under the mine, but could be 100% to 200% of the annual recharge reaching these aquifers. Based on pump test data furnished by the company, it is estimated that drawdown in the basal sandstone would occur within a radius of 2 or 3 miles around the mine. Data on movement of water between aquifers are insufficient to permit assessment of impacts on surrounding wells that tap shallow aquifers. If any water supplies were depleted, the mine company would be required by Wyoming laws and 30 CFR 700 to provide a replacement supply. The number of years after pumping stopped until the groundwater aquifers would recover to the existing storage level would be about one to one and one half times the number of years over which pumping occurred or 40 to 60 years. If pumping at the proposed rate continued for the proposed life of the mine, reduced water levels would exist until late in the 21st century.

The company proposed two alternatives for disposing of waste from the coal washing process. The primary proposal calls for wastes to be piped to a closed playa in Section 32, T. 20 N., R. 91 W. An unknown percent of the water used for transporting wastes to the playa would be decanted and returned to the washing plant. Therefore, only a moist residue would remain. Soils at the playa are extremely tight and are highly mineralized. With the combination of little water and tight impermeable soils, the playa most likely will become only an evaporation area and little or no water would enter the groundwater system. However, there is some risk that this would not be true. The decanting procedure could be less efficient than assumed, and soil permeability could increase if kept constantly wet. If water did enter the groundwater system it could present a slight risk of additional mineralization as discussed under quality. Most of the water from the waste would be decanted; therefore there would be no potential for minerals from the waste material to infiltrate to regional aquifers.

Surface Water

A few localized impacts would occur along streams, but none of these would cause a significant change in the water resources of the surrounding area. Drainage patterns would be altered on the mined area. The proposed route for the rail spur and the pipelines to and from the tailings pond would cross Fillmore Creek, an ephemeral stream that drains to a closed basin. Stream velocities could be increased through constricted openings at these crossings, thus increasing erosion near the crossings, but sediment would not be transported far and would have little additional impact. The proposed relocation of the 230-kv power line also crosses Fillmore Creek, but no impact on the creek is anticipated. The rail spur, pipelines, highway, adjacent power and telephone relocations, the 230-kv relocation, and haul roads all cross a few minor drainages, but impact from these facilities on the generally dry ephemeral drainages would be of no consequence.

Two or three small stock ponds would be destroyed, but could be replaced after mining. If the water supply provided by the reservoirs was needed during the period of mining, the company would have to provide an equal supply from some other source in order to be in compliance with regulations of SMCRA and Wyoming statues. Otherwise the ponds would be replaced after mining.

Quality

Oh! Here = Cow Bu
Bas

The proposed mine would not alter a recharge area and water is already so heavily mineralized, containing dissolved solids concentrations of several thousand mg/l (see Chapter 2), that it is unsuitable for most uses. The mine area is thought to be in a discharge area so it is unlikely that contamination could result.

Impacts to water quality from mining operations and from construction and use of road and railroad facilities would be negligible. Although there is little potential for water to reach the water table from wastes placed in the playa, there is a small risk that some water could reach the water table and would carry with it toxic elements that may have accumulated in the playa over a long period of time. It would be possible for underflow to migrate on shallow dense salt deposits to ephemeral stream channels. Therefore, the second alternative of burying the wastes in the mine pit should be used. Since water is known to move upward at the mine site, there would be little potential for contamination of the adjacent aquifers if the waste disposal area was kept above the water table.

There is very little potential for any increased mineralization of surface streams. The streams flow less than 5% of the time and carry only a few cfs at a time. It is unlikely that any runoff from disturbed areas will be released from the project area. Any runoff that left the mine site would have to be treated to meet standards established by EPA, Wyoming DEQ, and SMCRA. Treated water must be of much better quality than is present in natural streams. The mine plan and SMCRA commit the company to handle surface drainage in a way that will eliminate any potential for contamination. Mine drainage used for dust control would not affect surface quality because the quantity used would be extremely small and the quality of this groundwater would be approximately the same as the natural quality of surface water.

The hydrologic and legal limitation discussed in Chapter 4 of the Regional Analysis would prevent significant movement of sediment. Even if the sediment load were increased in the small ephemeral streams, there would be no impact because no fisheries or man made developments exist that could be impacted.

Water Use

In 1985, the mine would use water at the rate of 250 ac ft/yr for dust control, equipment washing, etc., and 230 ac ft/yr for washing coal. By 1990 these figures would increase to 300 ac ft/yr and 270 ac ft/yr respectively. The use rate would remain constant until the end

of mine life in 2024. The population increase resulting from the mine would require an annual water supply of 170 ac ft/yr in 1985, and 180 ac ft/yr from 1990 until end of mine life. This mine would increase water use in the ES region by 0.4% which by itself would be insignificant.

VEGETATION

Terrestrial

The disturbance of the vegetative resource on the Cherokee project area would begin in 1982 with the construction of mine and ancillary facilities and would be continuous until the completion of mining operations in 2024. The acreage of vegetation that would be disturbed by the development of the project is shown in Tables CH3-1 and CH3-2; the vegetative types that would be disturbed are shown in Table CH3-7. The primary vegetative type that would be disturbed is the big sagebrush type that comprises about 96% of the final contour area (Figure CH3-2).

The construction of mine and ancillary facilities, begining in 1982, would disturb 617 acres of vegetation. The acreage would be out of production for the life of the mine.

Mining would begin in 1984 with full production attained by 1986. The cumulative acreage that would be disturbed by the end of designated time periods would be 1,131 acres by 1985; 2,468 by 1990; and 7,623 by the end of mine life.

During the 1986 to 1990 period, the relocation of State Highway 789, a 19.8-kv power line, and a telephone line would disturb approximately 190 acres of vegetation. The relocation of the 230-kv power line would disturb a minor amount of vegetation on 21 acres on a site just north of the project area during the construction phase only. The disturbance would not cause a total destruction of the vegetation except at structure locations. Most of the disturbance would be caused by vehicles and equipment traveling over the vegetation during the construction phase. The vegetation is expected to recover within 5 years after the construction period and only minimal reclamation measures would have to be applied.

Population increases associated with development of the project would result in the destruction of 249 acres of vegetation by 1985. This acreage would be distributed at various population centers of the region for housing and support services. Rawlins is expected to receive the majority of this population growth.

The total vegetative disturbance that is expected to occur as a result of mining, development of mine and ancillary facilities, highway relocation, and population increase during designated time periods would be: 1982 to 1985—2,023 acres; 1986 to 1990—1,517 acres; 1991 to end of mine life—5,155 acres. The cumulative acreage disturbed for like time periods would be 2,023; 3,540; and 8,695 acres respectively.

During the initial opening period (1982 to 1985), the rate of disturbance would be approximately 283 acres per year with the development of this mine area, topsoil storage areas, haul roads, gravel pits, etc. Development would continue into the second period (1986 to 1990), but the disturbance per year would decrease to an average of 267 acres. Thereafter, the disturbance would be confined to that caused by mining (approximately 166 acres per year).

Reclamation would occur concurrently with mining after the initial opening period at an average rate of approximately 190 acres per year. The amount of land out of production at any one time would range from 1,500 to 2,275 acres; composed of 40% unreclaimed acreage and 60% reclaimed acreage in various stages of development, but unable to support grazing. The cumulative acres of final contour area to be reclaimed (topsoil replaced and seeded) by the end of designated time periods would be: 0 acres by 1985; 570 acres by 1990; and 8,245 acres by the end of the mine life.

With the assumption that reclamation would be conducted as proposed in the reclamation plan and that revegetation would occur in the sequence as outlined in the guideline section, the following is a description of vegetative establishment that is expected to occur.

Vegetative type conversion to grassland type from the present vegetative types is likely to occur on the reclaimed areas since it would be difficult to reestablish the plant species indigenous to the area by the seeding method. The expected alteration of soil structure and microclimate environment would not be conducive to production of present plant species and composition during the life of the mine. The ultimate vegetative production capability of the reclaimed land is expected to average approximately 800 to 850 pounds of air dry vegetation per acre. At the initial seeding, the soil productivity level is expected to be approximately 75% of potential and vegetative establishment approximately 70% successful (see Figure CH3-1). This would result in a vegetative production of approximately 280 pounds per acre. Subsequent spot seeding and further establishment of vegetative cover through resting the area would result in an average vegetative production of approximately 420 to 450 pounds per acre. This would include an estimated composition of 85% grasses, 10% forbs, and 5% shrubs at the end of the 7½ year reclamation guideline. At this point, adequate forage would be available for cattle grazing at the level presently authorized. Forage for sheep and wildlife would be inadequate due to vegetative composition of the reclaimed areas. The grassland type of vegetation would furnish approximately 10% to 15% of wildlife needs. In time, further soil development would occur, and through natural plant succession, vegetative production would increase to the 800 to 850 pound per acre level and composition would change with significant increase in shrub populations, maintenance of grass production, and a slight reduction of forb production. A vegetative composition similiar to present day composition is expected to be attained on the area approximately 40 years after initial reclamation effort. Since the management objective is to restore the lands as sheep and

Table CH 3-7

NONCUMULATIVE AND CUMULATIVE ACREAGE OF VEGETATIVE TYPES
DISTURBED BY VARIOUS FACILITIES OR ACTIVITIES BY TIME PERIODS

FACILITY OR ACTIVITY	RANGE TYPE AND TIME PERIOD Big Sagebrush 4 1985	1990	1990+	Total	Birdfoot Sagewart 4a 1985	1990	1990+	Total	Greasewood 14 1985	1990	1990+	Total	Barren 8 1985	1990	1990+	Total	TOTAL
FINAL CONTOUR	1,111 (1,111)*	1,265 (2,376)	4,927 (7,303)	7,303	-- --	-- --	188 (188)	188	-- --	12 (12)	-- (12)	12	20 (20)	60 (80)	40 (120)	120	7,623
MINE FACILITIES	207 (207)	-- (207)	-- (207)	207	4 (4)	-- (4)	-- (4)	4	21 (21)	-- (21)	-- (21)	21	4 (4)	-- (4)	-- (4)	4	236
ANCILLARY FACILITIES	146 (146)	-- (146)	-- (146)	146	20 (20)	-- (20)	-- (20)	20	35 (35)	-- (35)	-- (35)	35	180 (180)	-- (180)	-- (180)	180	381
RELOCATIONS	26 (26)	176 (202)	-- (202)	202	-- --	4 (4)	-- (4)	4	-- --	-- --	-- --		-- --	-- -j	-- --		206
TOTAL	1,490 (1,490)	1,441 (2,931)	4,927 (7,858)	7,858	24 (24)	4 (28)	188 (216)	216	56 (56)	12 (68)	-- (68)	68	204 (204)	60 (264)	40 (304)	340	8,446

*() = Cumulative data

Figure CH3-2

TYPICAL VIEW OF THE BIG SAGEBRUSH TYPE (TYPE 4) THAT WOULD BE DISTURBED ON THE CHEROKEE PROJECT

cattle range and habitat for wildlife in a timely manner, additional mitigation measures would have to be applied to reclaimed areas to attain the objectives of post-mining land use and requirements of the law.

Haul road dust and fugitive coal dust from mining, blasting, transporting, processing, and loading may be deposited on vegetation adjacent to the activity areas. Dust covered vegetation would be less palatable to livestock and wildlife.

Another impact from the destruction of native vegetation could be the invasion of noxious weeds onto the disturbed areas which would compete with revegetation efforts and could inhibit the establishment of permanent vegetative cover.

Young palatable vegetation produced by revegetative efforts would attract livestock and wildlife. The grazing of the young plants would inhibit growth vigor and cause delay in the establishment of vegetative cover.

Endangered and/or Threatened

A field examination was made on the Cherokee project area during June 1977, and no threatened or endangered plants were found. It was concluded that the chance of any endangered or threatened plants being present is near zero (BLM Memo, 4510 (932), July 22, 1977).

FISH AND WILDLIFE

General Information

Impacts to the wildlife resource can be broken down into two general categories: (1) loss of wildlife habitat and the associated wildlife carrying capacity of that habitat; and (2) the actual loss of wildlife populations, their progenies progeny, and so on for the entire period of mining activities.

The proposed mine would remove a total of 8,446 acres of wildlife habitat. The various vegetative types disturbed (includes "zone of influence") would be sagebrush—9,838 acres; greasewood—327 acres; birdfoot sagewort—300 acres; and barren—206 acres.

Habitat Losses

The mining would result in both direct and indirect losses of wildlife habitat. Direct losses would include habitat that is actually removed by the mining operation and construction of ancillary facilities. Losses of habitat that could be classed as indirect would be those areas of habitat that are not physically removed, but are areas that are outside the mined area that become temporarily unusable by wildlife because of isolation, noise, dust, etc. These areas of indirect loss could also be called a "zone of influence"around the mining area. Direct losses of habitat on the project area would be 1,774 acres by 1985 composed of 1,490 acres of sagebrush (84%); 24 acres of birdfoot sagewort (1%); 56 acres of greasewood (3%); and 204 acres of barren land (12%). Losses of wildlife habitat by 1990 would total an estimated 3,291 acres composed of 2,931 acres of sagebrush (89%); 28 acres of birdfoot sagewort (1%); 68 acres of greasewood (2%); and 264 acres (8%) of barren land. Estimated losses of wildlife habitat by the end of mine life (year 2024) would total an estimated 8,446 acres which are made up of 7,858 acres (93%) of sagebrush; 216 acres of birdfoot sagewort(2%); 68 acres of greasewood (1%); and 304 acres (4%) barren land (see Chapters 4, 5, and 6).

The loss of wildlife carrying capacity for various species would also be associated with the actual loss of habitat.

Wildlife Population Losses

Wildlife populations in the project area would be lost or reduced with the advent of mining activities. These losses would increase as the size of the disturbed area increases during the period of mine life.

Wildlife

Birds

Nongame. The major small nongame songbirds that would be lost or displaced by the loss of 8,446 acres of habitat would be: horned larks, sage sparrows, sage thrashers, Brewer's sparrows, vesper sparrows, and green-tailed towhees. The best available bird population density estimate presently available for the project area is an average of 21 breeding pairs per 100 acres, ranging from 8 to 55 pairs per 100 acres. Populations of small birds such as these tend to average a complete population turnover every 3 years with each nesting pair fledging an average of three young per nest (personal communication, Max Schroeder, USFWS, March, 1978).

It is not possible to calculate a good population estimate for small birds because there are not enough natural mortality data available from the literature to enable a computer simulation to be completed (see Chapter 6). However, if it is assumed that small birds occur equally spaced over the entire project area, estimates of small bird losses may total 79% of the population. Additionally, this loss is estimated to be less than 1% of the regional population.

Reclamation plans propose to return the vegetation to a perennial grass complex. This change in vegetation could alter the species makeup of the small bird population in the area. Habitat for sage thrashers, Brewer's sparrows, horned larks, etc. would be removed and grassland species such as lark buntings, meadow larks, etc., may filter in to inhabit the area.

Game. Sage grouse are the major game bird that would be significantly impacted by the proposed action. The Wyoming Game and Fish Department classifies the entire project area of 10,671 acres as good year-round habitat for sage grouse (see Table CH3-8 for acres of

grouse habitat lost by time periods). Mining activities would destroy three sage grouse strutting grounds or leks on or immediately adjacent to the project area (Map 8A, Appendix A). In addition, the local population of grouse associated with these breeding complexes would be lost. Additionally approximately 10,586 acres of crucial nesting habitat associated with the three breeding areas would be lost, (see Chapters 5 and 7) thus compounding the grouse losses over the life of the mine (Map CH2-4). The crucial nesting habitat is located on 8,108 acres of sagebrush; 300 acres of birdfoot sagewort; and 246 acres of greasewood. These data indicate that 82% of the sagebrush on the project area is used as crucial nesting cover by the grouse. Additionally 100% of the birdfoot sagewort and 75% of the greasewood type is also utilized as crucial nesting habitat.

Census counts of male grouse on the strutting grounds were conducted during the spring of 1978. At the peak of the display period, the maximum count was 97 male grouse on the three leks. By utilizing a life equation model for a stable sage grouse population (Wallestad 1975:27) and designing a computer program that takes into account mortality (by sex and age, by season) number of eggs produced and hunting mortality, it is possible to simulate the population over any length of time needed. The computer output totals the birds produced and lost over the time period asked for, assuming the population is stable. The simulation estimates that by 1985, a total of 1,114 sage grouse would be lost for hunters and nonconsumptive users if the three leks were destroyed. By 1990, a total of 2,506 birds would be lost and by the end of mine life an estimated 11,143 grouse would be lost as a direct result of the proposed action (see Chapters 4, 5, 6, and 8).

This loss of 11,143 birds would be a significant loss to the local population since the three leks on the project area are the only ones within 4 miles of the site. It is estimated that the entire production of sage grouse in the vicinity of the Cherokee project area is connected with the three leks found on or near the site.

Mourning doves feed and nest on the proposed site, but the habitat is marginal at best because of the uniformly poor quality habitat throughout the area. No data exist at the present time as to numbers of birds nesting on the area or estimated production. It can be said, however, that approximately 8,446 acres of poor quality nesting habitat for doves would be lost over the life of the mine (see Chapter 6). Moreover, if it is assumed that doves are spaced equally over the project area, estimates of dove losses would be 79% of the population on the site. This loss is estimated to be less than 1% of the regional population.

Mammals

Nongame. The principal small nongame species found on the project area include deer mice, least chipmunks, Richardson's ground squirrels, and whitetail jackrabbits. Removal of topsoil and storage for later reclamation would cause direct mortality to small burrowing rodents. Losses due to these and other mining activities would not only result in direct mortality, but losses would also be caused by displacement of more mobile animals. Quantification of these losses by computer simulation is not possible at the present time because published mortality data for small rodents are rare, and not available at all for southcentral Wyoming. Losses of small rodents on 8,446 acres over the life of the mine would be heavy, but the high reproductive potential of these species indicated the repopulation of reclaimed mine areas would be rapid (see Chapter 6). If it is assumed that small rodents space themselves equally over the project area, estimates of losses would be 79% of the total population. These losses would total less than 1% of the regional population (estimated). The revegetation of mined areas to a grass complex could result in a different small mammal population, since small rodents that frequent shrub habitat would not infiltrate back into a reclaimed area planted to grass (personal communication, Max Schroeder, USFWS, March 1978).

Game. The Wyoming Game and Fish Department classes the entire project area of 10,671 acres as year-round pronghorn habitat. Of this acreage, an estimated 2,983 acres are classified as crucial winter range (Map CH2-5). The proposed action would remove all of the crucial winter range. See Table CH3-8 for acreages of pronghorn range estimated to be lost during the projected mine life.

The proposed action would eliminate 22% of the sagebrush, 22% of the greasewood, and 22% of the birdfoot sagewort out of the estimated 48,000 acres of habitat available to pronghorns that utilize the Cherokee Mine site.

Mine associated activities and loss of habitat would displace the estimated 250 wintering pronghorns that occur on the area into surrounding ranges. Displacement of these animals would cause the loss of an estimated 125 pronghorn (50% of those that inhabit the area). However, the actual loss to the pronghorn resource would be much greater than the 125 animals, since the progeny of these animals, their progeny, etc., would also be lost to both hunter and nonconsumptive users.

Total losses of pronghorns over the period of mine life can be estimated by utilizing computer simulation techniques developed by Gross et al. 1973. Data used in the simulation were furnished by the Wyoming Game and Fish Department for pronghorn herds indigenous to the project area. The computer simulations estimate that 397 pronghorns would be lost as a result of the proposed action by 1985; 1,830 animals would be lost by 1990; and 5,828 pronghorns lost by the end of mine life (see Chapters 4, 5, and 6). Comparisons of these estimated losses to a total population figure are not possible since such data are lacking for this portion of the herd unit. However, it can be estimated that this loss would be less than 1% of the regional pronghorn population.

Increased losses of pronghorns would also occur due to increased automobile traffic, harrassment, increased poaching and, wanton destruction.

The project area supports a year-round resident mule deer herd of about ten animals with the eastern one-

Table CH3-8

WILDLIFE HABITAT LOST

Species and Habitat	Acres Lost During Time Periods 1970 to 1980	1980 to 1985	1985 to 1990	1990+	Total
Pronghorn					
Year-Round		2,067	1,459	7,235	10,671
Winter		14	311	3,310	3,637
Crucial Winter		---	220	2,763	2,983*
Mule Deer					
Year-Round		2,503	497	203	3,203
Sage Grouse					
Year-Round		2,067	1,459	7,235	10,671
Crucial Nesting		2,067	1,459	7,060**	10,568**

*Included in winter habitat
**Included within the year-round habitat

fourth of the project area being classed as year-round deer range. During the anticipated 40-year mine life, the actual surface mining and ancillary facility construction would result in the destruction of approximately 3,203 acres of year-round range. This loss of year-round range would include 2,674 acres of sagebrush; 94 acres of bird-foot sagewort; and 246 acres of greasewood.

Should this area be reclaimed to a plant community consisting primarily of perennial grasses, year-round range for mule deer would not be enhanced, since deer utilize grass only in the spring and even then only to a slight degree (Kufeld et al. 1973).

Deer occur primarily in the vicinity of Fillmore Creek and since a portion of this drainage is in close proximity to the area to be mined, mine associated activities and the loss of habitat would displace deer into adjacent ranges to the east. Significant losses of deer as a result of displacement are not anticipated (see Chapter 6).

Deer-automobile collisions, harrassment, poaching, and wanton destruction would all increase as a direct result of increased numbers of people in the area.

The complete removal of 8,446 acres of brushland habitat would result in a population loss to the high desert cottontail population on the project area. In this habitat type, the Wyoming Game and Fish Department estimates that there are about five rabbits per acre when the various vegetative types are averaged. Cumulative losses of cottontails cannot be simulated since mortality data needed for a simulation run are not available. However, if it is assumed that cottontail rabbits occur equally over the project area, it can be estimated that losses due to mining would total 79% of the population. It is also estimated that these losses would be less than 1% of the regional population. While losses could be heavy during mine life, the high reproductive potential of this species would enable it to quickly repopulate the area after reclamation is completed (see Chapter 6).

Reptiles and Amphibians

General

The principal reptile species that could possibly be impacted by the project include eastern shorthorned lizards, northern side-blotched lizards, northern plateau lizards, and prairie rattlesnake. Data on population densities and mortality rates are not available for this area or any area that is similar, so simulations of population losses cannot be run. However, if it can be assumed that reptiles space themselves equally over the project area, losses of these species would total an estimated 79% of the population on the mine site. These losses would be an estimated 1% or less of the regional population. Reproduction of these species is high enough so that repopulation would be rapid once reclamation is completed (see Chapter 6).

The lack of free surface water and riparian vegetation limits the occurrence of amphibians in the project area, so no impacts are anticipated to this class of animal.

Feral (Wild) Horses

There are no feral horses on the project area; therefore, impacts to these animals are not anticipated.

Endangered and/or Threatened

No federally listed endangered or threatened mammal species are known to inhabit the project area. At this time, and with current data, it is not anticipated that any adverse impacts would occur to any mammal listed in either of these categories. However, in accordance with Section 7 of the Endangered Species Act of 1973, formal consultation with the U.S. Fish and Wildlife Service has been requested concerning the possibility of black-footed ferrets being found in this area. This request was dated April 11, 1978.

No adverse impacts are anticipated to any federally listed bird species since none are known to inhabit the area.

No adverse impacts are anticipated to any listed fish, reptile, or amphibian since none are known to occur on the area.

CULTURAL RESOURCES

Determination of National Register eligibility is in process on two sites in the Cherokee project area. If they are determined to be of National Register quality, after consultation with the SHPO and the Advisory Council on Historic Preservation, 106 Compliance will be completed.

Sites located along rights-of-way associated with the Cherokee project area would also be handled under 106 Compliance procedures.

Subsurface sites which cannot be located prior to mining, may be impacted by mining operations.

VISUAL RESOURCES

Visual resource contrast ratings were derived for the Cherokee project area using places along State Highway 789 as critical viewpoints (Map CH2-6). These contrast ratings, summarized in Table CH3-9, are available for review at the Rawlins District Office of the BLM. Further explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is available in the library of the Rawlins District Office of the BLM.

Contrast ratings are assessed in terms of how the proposed action would affect the basic elements (form, line, color, and texture) of the existing landscape features, i.e., landform, vegetative patterns, and structures (power lines and buildings). Resultant contrast ratings are then compared to the maximum acceptable impact limit for the visual resource management (VRM) class as seen from a viewpoint. Two time periods (during active

Table CH3-9

SUMMARY OF VISUAL CONTRAST RATINGS FROM CRITICAL VIEWPOINTS

Views From Critical Viewpoints	A	B	C-D
Visual Management Class	III	III	III
During Active Mining (Land)	3/20	3/20	3/26
Post Reclamation (Land)	2/17	2/17	2/19
During Active Mining (Vegetation)	3/30	3/30	3/30
Post Reclamtion (Vegetation)	2/15	3/20	3/23
During Active Mining (Structures)	2/20	2/20	3/30
Post Reclamation (Structures)	1/10	1/10	2/13

In a visual resource management Class III, the maximum acceptable impact should not exceed 2/16.

mining and post reclamation) were used for the proposed Cherokee Mine contrast ratings.

Viewpoints A and B

From these viewpoints, the northern portions of the project area are visible. Mining activities and structures in the Class III area would create strong contrast to all basic elements. The visual resource management class would change to a Class V in the actual mining area.

Viewpoints C to D

All mining activities and structures would be visible from this stretch of road.

The contrast ratings indicate that the proposed coal mining would create strong contrast to line, form, color, and texture. Spoil piles, pit headwalls, coal storage, and topsoil piles would be visible along this stretch of State Highway 789. Transmission lines, pipelines, and roads would be moved. These activities would change the visual resource management class from a Class III to a Class V.

RECREATION RESOURCES

Visitor Use Data

Table CH3-10 depicts estimated resident visitor use changes by activity due to coal mining in the years 1980, 1985, and 1990. The changes are those which would occur in the region and result from increased population in Carbon County. Data used to calculate use are available in the files at the BLM Rawlins District Office.

Hunting

Adverse impacts to hunting would result when restricted access or displacement occurs to deer, antelope, rabbit, rodent, coyote, and game bird populations. This would result as construction and mining removes wildlife habitat (see Fish and Wildlife). With an increased number of people in the area some ranchers would restrict access across private lands. Increased human population would induce a greater demand for hunting and decrease the quality of the hunting experience in the area.

Sightseeing

The construction and mining would cause adverse impacts to existing recreational sightseeing values in the area. There would be adverse impacts to wildlife sightseeing due to the displacement of animal species. However, there would be opportunities for geological and industrial interpretation as the mining operations draw people in to view the area.

Specialized Activities

Off-road vehicle use by four-wheel drive enthusiasts would be restricted from the mining area for safety reasons.

General

With an increased visitor use due to increased population in Carbon County, there would be a general lowering of the quality of the outdoor recreation experience in the area surrounding the Cherokee project. There would also be increased use in urban recreation areas in the city of Rawlins and the town of Wamsutter.

AGRICULTURE

Livestock Grazing

The disturbance of vegetation through the development of this project would affect the grazing on the Riner and Echo Spring grazing allotments. The Echo Springs allotment would be affected by the relocation of Highway 789 which would reduce the acreage of the allotment by approximately 1,750 acres (2.7% of the total allotment acreage). This reduction of 1,750 acres (one-half federal and one-half private), translates into a permanent loss of approximately 175 animal unit months (AUMs) of grazing annually on this allotment. It is presumed that this loss could be absorbed in the remainder of the allotment and no reduction in stocking would be necessary since the remaining carrying capacity of the allotment is within the AUMs of grazing permitted. At the completion of reclamation, this acreage and associated AUMs of grazing would be included into the Riner allotment. The acreage that would be disturbed on the Riner allotment would consist of 617 acres utilized in the construction of mine and ancillary facilities and 6,097 acres disturbed within the final contour area.

As outlined in the assumptions and guidelines section, vegetative cover would be established 4½ years after initial seeding. Under the reclamation procedures as outlined in the proposed action, the resulting vegetation would be principally grasses (Chapter 3, Vegetation) and would be most suited for grazing of cattle. However, since the objective of reclamation is to return the land to its premining use of a combination of sheep and cattle grazing and wildlife habitat, the vegetation would not be suitable for these uses at this point of time. Grazing use would have to be withheld to permit the establishment of shrub species to desired density and compaction thru natural succession. It is estimated that it would take ap-

Table CH3-10

ESTIMATED RESIDENT VISITOR DAYS DUE TO
POPULATION CHANGE FOR YEARS 1980, 1985, 1990

	Fishing	General**	Hunting	Off-road vehicles	Urban recreation***	Water Sports****	Winter Sports*****
1977	76,997	98,839	24,432	2,957	47,013	35,537	9,440
1980 (population 0)*							
without proposed action	93,776	120,475	28,905	3,526	60,238	44,351	12,356
increase due to proposed action	0	0	0	0	0	0	0
total projection	93,776	120,475	28,905	3,526	60,238	44,351	12,356
% of projection due to proposed action	0%	0%	0%	0%	0%	0%	0%
1985 (population 967)*							
Without proposed action	115,001	150,058	34,527	4,245	78,879	56,570	16,998
increase due to proposed action	4,187	5,463	1,257	155	2,873	2,060	619
total projection	119,188	155,521	35,784	4,400	81,752	58,630	17,617
% of projection due to proposed action	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%

Table CH3-10

ESTIMATED RESIDENT VISITOR DAYS DUE TO
POPULATION CHANGE FOR YEARS 1980, 1985, 1990
(Continued)

	Fishing	General**	Hunting	Off-road vehicles	Urban recreation***	Water Sports****	Winter Sports*****
1990 (population 1,013)*							
without proposed action	132,872	175,342	39,437	4,850	94,953	67,044	20,628
increase due to proposed action	4,437	5,855	1,317	162	3,170	2,238	689
total projection	137,309	181,197	40,754	5,012	98,123	69,282	21,317
% of projection due to proposed action	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%

* Population changes due to project (Socioeconomics)

** General includes camping, picnicing, sightseeing, etc.

*** Urban includes rodeos, golfing, and attending athletic events.

**** Water sports includes boating, swimming, and water skiing.

***** Winter sports includes only skiiing.

proximately 40 years after initial seeding for natural succession process to establish the desired vegetative species and composition. Under this premise, the first acreage reclaimed would be released for full use in 2026 and the last acreage reclaimed would be released in 2065 unless additional measures are applied to reduce the time of reclamation and improve the vegetative composition of the reclaimed areas.

A mathmatical projection of the AUMs of grazing that would be lost by time periods is as follows: 443 AUMs by 1985; 1,785 by 1990; 5,935 by 2000; 18,915 by 2020; 33,484 by 2040; and 40,140 by 2065. The average loss of AUMs of grazing per year over the life of the mine and during reclamation would be approximately 478 (see Figure CH3-3).

The impact on range improvements would be primarily three stockwater reservoirs since they are located in the final contour area and would be destroyed. The removal of fences on the mining area would not affect livestock control since new fences would be constructed along the right-of-way of relocated Highway 789.

The mine and associated facilities would have minimal effect on livestock movements since they would be located next to boundaries of grazing areas. No vegetative damage is anticipated from trailing of livestock or other livestock concentrations.

MINERAL RESOURCES

Coal

The two impacts associated with mining would be the removal of 250 million tons of coal and the loss of 27.8 million tons that would be unrecoverable (left in the ground) due to present mining methods. Losses would be primarily caused by dilution with waste material at the top and bottom of the coal seam.

Sand and Gravel

An estimated 5,100 cubic yards of sand and gravel would be used for concrete aggregate in construction of the mine facilities.

Scoria

The 7.7-mile railroad spur would require 6,600 cubic yards per mile or a total of 50,820 cubic yards of scoria. The 4.7-mile access road and 6.7-mile relocation of State Highway 789 would require 6,000 cubic yards per mile or a total of 68,400 cubic yards of scoria.

Oil and Gas

There are existing oil and gas leases within the project area and active exploration in progress. No impact is expected since oil and gas exploration can be resumed after mining.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

The land in this area is zoned for ranching, agriculture, and mining, with the exception of a scenic corridor extending 2,000 feet on each side of State Highway 789, which would be impacted by the proposed mining (see Map CH2-6). The zoning, however, does not legally preclude mining within the scenic corridor.

SOCIOECONOMICS

Demographics

Population

The proposed Cherokee project would result in a population increase of 1,013 people in the Carbon County communities of Rawlins and Sinclair and in the Sweetwater County community of Wamsutter (Table CH3-11). Most of the population growth would occur between 1982, when construction would begin, and 1985. Rawlins, which is located about 30 miles from the project, would receive 90% of the population increase.

The 1985 population of Rawlins would be 5.2% greater than the expected population of 16,872 without this mine. This additional population increase would occur during a period (between 1977 and 1985) when Rawlins would experience a moderate average growth rate of 6.1% due to current coal development in the Hanna Basin and anticipated development of Red Desert area uranium.

Wamsutter is located about 18 miles from the Cherokee project. The mine would cause Wamsutter's 1985 population to be an estimated 7.8% greater than the 1985 population of 631 which is expected without additional federal coal actions. This additional population would occur during a period (between 1977 and 1985) when Wamsutter would experience a moderate average annual growth rate of 7.8% due to anticipated development of Red Desert uranium.

Employment

Construction on the Cherokee project would start in 1982 and be completed by 1985. The permanent work force at the mine would gradually increase between 1982 and 1985, eventually reaching a level of 285 permanent workers.

Miners and mine-related construction workers receive higher wages than employees in other sectors of the

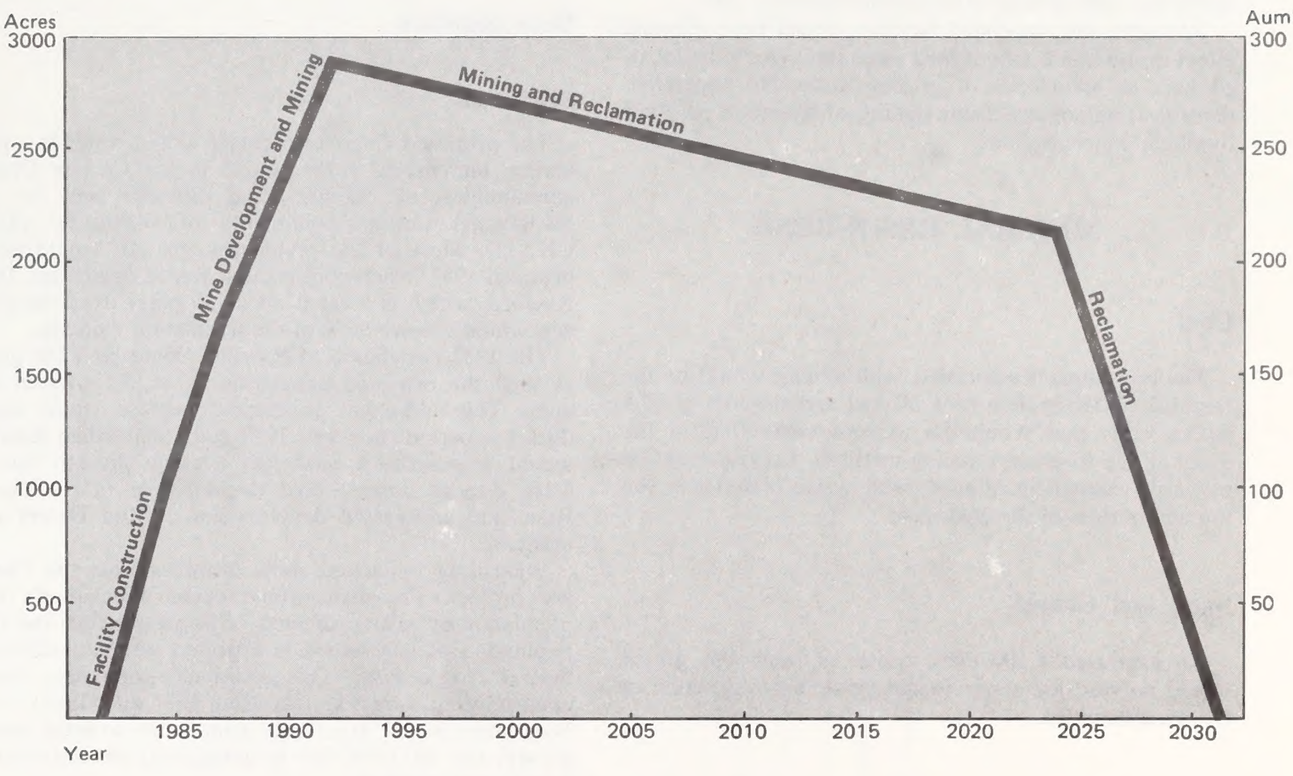


Figure CH 3-3

ACRES OUT OF PRODUCTION AND AUM'S LOST BY RINER GRAZING ALLOTMENT
Cherokee

Table CH3-11

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

County City	1977 Population	1980 Total with the Proposed Action	1980 Impact of the Proposed Action	1985 Total with the Proposed Action	1985 Impact of the Proposed Action	1990 Total with the Proposed Action	1990 Impact of the Proposed Action
Carbon County*	8,137	21,577	0	26,821	918	30,501	971
Rawlins	10,500	13,263	0	17,752	880	20,897	938
Sinclair	550	560	0	607	38	609	33
Wamsutter (Sweetwater County)	347	463	0	680	49	823	42

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Insitute, Laramie, 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

economy, so the Cherokee Mine would be in a favorable situation to compete with other employers in the region for the available labor supply. This may lead to a slower growth in employment in the other sectors than would be expected. In 1985 (see Table CH3-12) there would be 485 workers (285 miners and 200 construction workers) employed at the Cherokee Mine. However, total employment in the region would only increase by 436 workers, so the mine employment would cause a net decline of 48 workers in other sectors of the economy. This impact would be felt most strongly in agriculture, retail trade, services, and some local government departments such as police and fire where wages are traditionally low. This would be a temporary situation which would disappear when migration increases the available labor supply sufficiently to supply all potential employees.

In a report by F.L. Leistritz and T.A. Hertsgaard, it was shown that when industry (coal development) moves into a rural area, farm and ranch operators are faced with the necessity of offering higher wages or reorganizing their farms or both. Operators of small farms and ranches who have been underemployed in their farm or ranch business may take advantage of the new off-farm job opportunities that coal development provides.

Operators who are fully employed with adequate incomes from agriculture and who do not hire much extra labor would be least affected by increased competition for labor. Those operating large farms and ranches requiring large amounts of labor would be likely to make significant adjustments in their operations. These adjustments would likely include dropping certain labor-intensive enterprises, adopting labor-saving technologies, and perhaps even reducing the size of their operation.

New mining activity creates a need for additional employment in industries which serve the mine (e.g., mine supply firms) and in businesses and organizations which serve the new mine and mine-related employment (e.g., merchants, storekeepers, and school teachers). By 1990, the Cherokee Mine would create 461 new jobs in the Carbon County economy, which represents a total employment to direct mine employment ratio of about 1.6 (Centaur 1978).

Income

The proposed Cherokee Mine would increase annual personal income in the region $15.8 million (in constant 1977 dollars) by 1990 because of increased wage earnings ($9.7 million) and proprietor's income ($6.1 million). This would be an increase of 3.5% over the 1990 personal income expected without the proposed action. With 461 additional workers employed in 1990 as a result of the proposed action, the $9.7 million rise in wage and salary income represents an increase of $21,100 (in constant 1977 dollars) per additional worker (Centaur 1978).

This increase in income would create local inflationary pressures. This would occur because the miners and mine-related employees would have more money to spend on goods and services than would others. This would affect those on fixed incomes (retirees, welfare recipients, etc.) more than anyone else. As incomes and prices rise rapidly, their incomes do not. This effectively reduces their buying power.

Infrastructure

Private Sector

The increase in personal income in the region that would result from the proposed Cherokee project would generate additional wholesale and retail sales. These additional sales are expected to be $6.3 million in 1985, and $6.6 million in 1990 (in constant 1977 dollars) (Centaur 1978).

Along with these increased sales, there would be diversification of business types to take advantage of the new sales opportunities. New business would locate in the region that have not been represented in the local economy previously.

About 91% of the population increase resulting from the proposed Cherokee Mine would live in Rawlins, and the remaining population would do some shopping there, so most of the additional sales generated by the proposed action would occur in Rawlins.

Housing

The proposed Cherokee project would create an additional housing demand of 495 units (324 single family units) by 1990 (Centaur 1978). About 90% of this demand would be felt in Rawlins.

Housing demand is based on the historical relationship of 2.7 persons per housing unit in Carbon County. Housing shortages, which would be reflected by occupancy rates greater than 2.7 persons/housing unit, are difficult to anticipate. No major constraints to rapid expansion of mobile homes are known—trailer parks can be built quickly, financing has not been unduly difficult to obtain, and water and sewer moratoriums in several communities have recently been lifted because of new construction which has increased water and sewer capacities. However, some new residents are likely to rent rooms in existing homes, live temporarily in motels, or share rental units with others, because they prefer these alternatives to mobile homes or because they are waiting for other housing to become available. All these alternatives would raise the occupancy rate and thus create living conditions more crowded than typical.

Demand for single family homes is estimated based on the expected preferences of new residents and long-time residents. New residents are often reluctant to purchase or build homes so they would exhibit fewer demands for single family homes than those who have lived in the community for a number of years. The supply of single family homes is not expected to rise sufficiently to meet this increased demand. Single family shortages now exist (partially the result of past construction moratoriums) and would likely become larger as a result of the proposed action.

Table CH3-12

SOUTHCENTRAL WYOMING EMPLOYMENT

Sector	1977 Total Employment	1980 Total with the Proposed Action	1980 Impact of the Proposed Action	1985 Total with the Proposed Action	1985 Impact of the Proposed Action	1990 Total with the Proposed Action	1990 Impact of the Proposed Action
Farm	526	525	0	525	0	525	0
Manufacturing	360	386	0	427	0	468	0
Mining	1,658	2,362	0	3,087	+285	3,013	+285
Construction	715	1,054	0	1,317	+185	1,513	+28
Government	919	1,018	0	1,411	-8	1,803	+49
Farm and Forest Processing	46	47	0	48	0	49	0
Railroads	480	540	0	680	0	780	0
Business Services	1,415	1,589	0	1,990	-15	2,474	+41
Consumer Services	1,948	2,102	0	2,465	-11	2,935	+58
Total Employment	8,067	9,533	0	11,950	+436	13,563	+461

Note: The impact of the proposed action is the difference between total employment with the proposed action and total without the proposed action.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming Water Resources Research Institute, Laramie, 1978.

Education

School age population would increase only in School District 01 as a result of the Cherokee Mine, with most of the impact concentrated in Rawlins. This increase would be 261 by 1990 (Centaur 1978). Combining the district's current capacity of 3,368 (1977 to 1978) with district plans to open the new Rawlins Junior High in 1978 and the new elementary school by the early 1980s indicates that school capacity would be adequate to meet increases resulting from the proposed action.

Assessed value of School District 01 would be increased by the value of the mine property. (Mineral properties are assessed based on the value of the previous year's production).

Health Care and Safety

The level of health care available in Carbon County is currently inadequate, with far fewer physicians and dentists available than are needed by the existing (1977) population. With the proposed action the present inadequate availability of health care specialists would worsen slightly. By 1990 the Cherokee project would lead to a need for one additional dentist, three registered nurses, and less than one physician and professional mental health counselor (Centaur 1978).

The Memorial Hospital in Rawlins presently has a capacity for a population of about 29,000 to 33,000, compared to Carbon County's 1977 population of 18,137. Even with the additional 1,013 people that would come into the region as a result of the Cherokee Mine, the hospital would still have considerable excess capacity.

In 1974, the incidence of work-related injury or illness in Wyoming for all industries was 10.4 cases per 100 full-time workers (this is the same incidence rate as for the United State as a whole—U.S. Department of Labor 1976). Bituminous coal mining in Wyoming appears much safer than the average industry with 5.2 cases of injury or illness per 100 full-time workers (for the United States, the incidence rate for bituminous coal mining is 10.6 cases per 100 full-time workers). If the incidence rate for injury and illness in bituminous coal mining holds in the future, the additional coal mining at the Cherokee Mine would increase injury and illness by an average of 14.8 cases per year. An unquantifiable number of these would be fatal or debilitating. Because bituminous coal mining appears safer than the average industry, this increase in injury or illness is less than would be expected from employment increases in other sectors of the economy.

Local Services

The proposed Cherokee Mine would lead to increased population in Rawlins, Wamsutter, and Sinclair, placing additional demands on the local services these communities provide. Since 90% of the population increase from the mine would reside in Rawlins, the demands placed on the local services in Rawlins would be quite significant (9% of the increased demand in 1990 would be due to the Cherokee Mine). Impacts on the towns of Sinclair and Wamsutter, as well as Carbon County, would be insignificant.

Transportation and Utilities

Impacts to transportation and utility systems in the area would result from: (1) mining activities requiring destruction and relocation of roads, power lines, telephone lines, etc; (2) transportation of coal out of and supplies into the area; and (3) increased employment and population with its increased number of vehicles and miles traveled.

On the project area, there are approximately 10 miles of unimproved dirt roads used by hunters, other recreationists, and by ranchers for access to livestock range. Most of these roads would be severed by mining operations. Loss of these roads would cause an unquantifiable inconvenience to those users. Construction of the railroad spur would temporarily disrupt traffic across some lesser and lightly traveled roads during construction. The increased employment and population associated with this mine would increase vehicle traffic, especially on Interstate 80 and State Highway 789. Highway access to the Cherokee project is via State Highway 789. A 4.7 mile access road would be built by the mine operator to connect surface facilities at the mine to the highway (Map CH3-7).

Several relocations would be required for the Cherokee Mine. These would include 6.7 miles of Wyoming Highway 789, a telephone line (2.1 miles), a 19.8-kv power line (6.9 miles), and a 230-kv power line (8.5 miles).

The impacts of these relocations would be; (1) loss of vegetation (see Vegetation), (2) wildlife disturbance (see Fish and Wildlife), (3) loss of archeological resources (see Cultural Resources), (4) visual disturbance (see Visual Resources), and (5) a temporary disruption in service during the relocations. In addition, a new 115-kv power line would be built parallel to the existing 230-kv line from Sinclair to the mine boundary, and then south to the mine facilities in Section 8, T. 19 N., R. 92 W. Impacts of this construction would be the same as those due to the relocations. This line would be 36.5 miles in length.

Train activity from the mine would add about three trains daily to the existing rail traffic. This represents about 4.5% of the total daily train traffic currently using the Union Pacific main line (Table CH3-13). As a result, air pollution, noise emissions, and traffic delays at railroad crossings would increase. The effect of increased air pollution emissions is not expected to be significant, since wind would dissipate the air pollutants, keeping concentrations at low levels. Noise emissions would occur more frequently, but here again the impact would not be significant.

The third impact, traffic delays at railroad crossings in communities along the line would increase measurably. Delay time at railroad crossings would increase about an hour a week or 8 minutes more a day. Currently, rail traffic causes delays and inconveniences in a number of

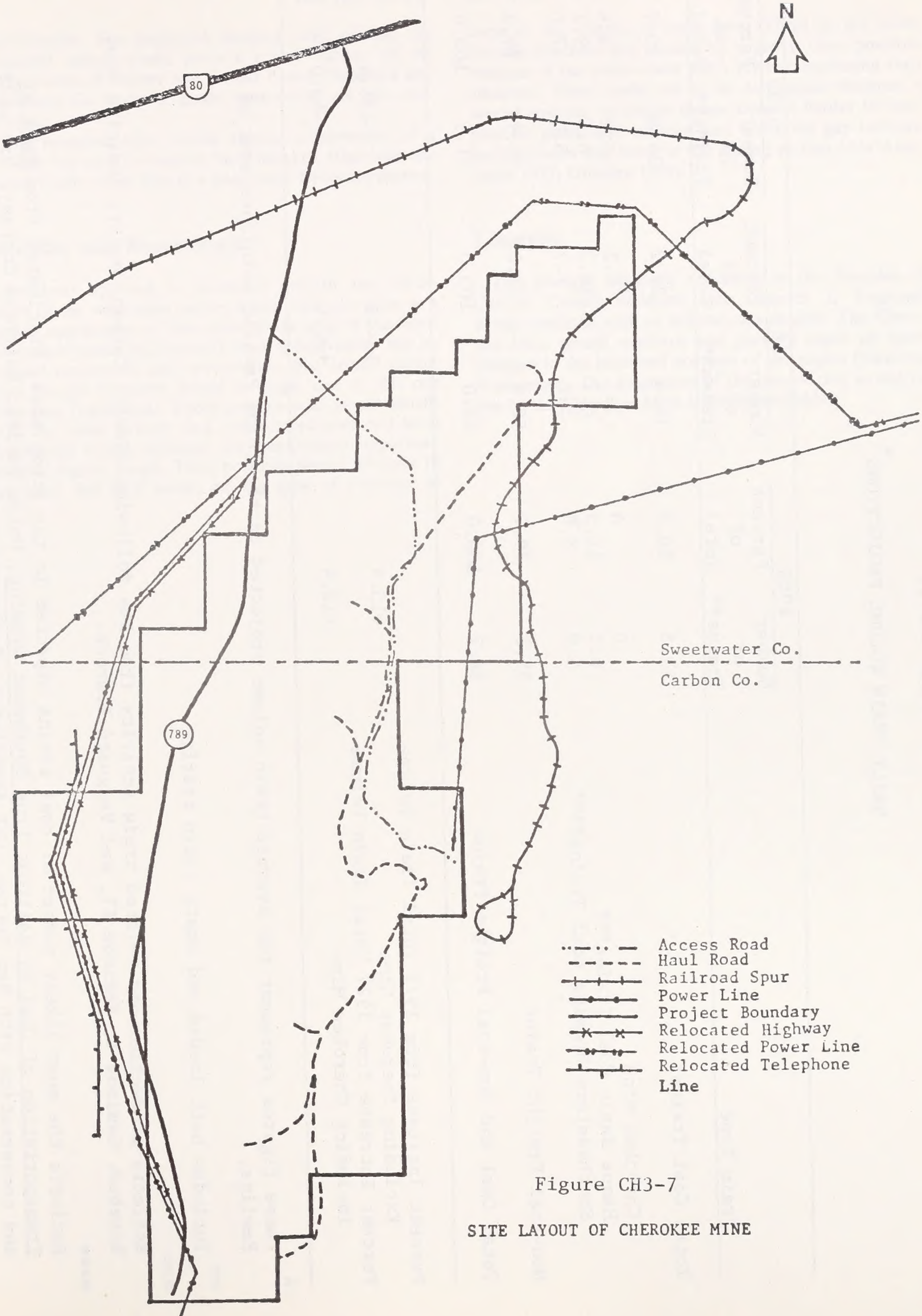


Figure CH3-7

SITE LAYOUT OF CHEROKEE MINE

Table CH3-13

DAILY TRAIN VOLUME PROJECTIONS*

Train Type	1980		1985		1990	
	Number of Trains**	Percent of Total	Number of Trains**	Percent of Total	Number of Trains**	Percent of Total
Total Coal Trains:	11.5	20.3	14.4	22.2	14.8	20.7
Cherokee Mine	0	0	2.7	4.2	3.3	4.6
Hanna Basin Coal Trains***	6.5	11.5	6.7	10.3	6.5	9.1
Southwestern Wyoming Coal Trains****	5.0	8.8	5.0	7.7	5.0	7.0
Non-coal Freight Trains	45.2	79.7	50.6	77.8	56.7	79.3
Total Coal and Non-coal Freight Trains	56.7	100.0	65.0	100.0	71.5	100.0
Percent Increase from 1977 Total Train Volume Excluding Cherokee Mine	+13.4		+24.6		+36.4	
Percent Increase from 1977 Total Train Volume Including Cherokee Mine	+13.4		+30.0		+43.0	

* These figures represent the average train volume projected on the Union Pacific mainlines east of Rawlins.

** Includes both loaded and empty train traffic.

*** Reflects production and related train activity from the following mines: Carbon County, Medicine Bow, Rosebud, Seminoe I, Seminoe II, and Vanguard-Rimrock.

**** Reflects the most likely number of coal trains expected in the study area. Estimated from Data on Transportation of Coal By Railroad From Southwest Wyoming, Union Pacific Railroad Company, May 1978 and conversation with Ron Dutton, ABT Associates, Englewood, Colorado, May 18, 1978.

communities. The projected increase even without the proposed action would place a severe burden on the communities of Sidney and Grand Island, Nebraska and Julesburg, Colorado if grade separations are not constructed.

The proposed mine would require construction of a 7.7 mile rail spur to connect the Cherokee Mine with the Union Pacific main line at a point near Creston Junction.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income), they would resent the increased population and urbanization that would occur, even though increases would be slight due to this one mine (see Population). Those persons who would benefit from the mine directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining section (Abt Associates 1977; Gilmore 1974).

Lifestyles

The changes currently occurring in the lifestyles of Carbon County residents (see Chapter 2, Regional) would continue with or without this project. The Cherokee Mine would reinforce and possibly speed up those changes in the impacted portions of the region (Rawlins, Wamsutter). The magnitude of the impact that would be due to the Cherokee Mine is not quantifiable.

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

This chapter includes mitigating measures and other regulations designed to lessen the potential impacts of the proposed action upon the existing environment. Each impact is listed under the environmental element to which it would occur, along with applicable regulations, an analysis of their effectiveness, and any remaining residual impact. The mitigation guidelines section provides the basis for the analysis of effectiveness and remaining unavoidable impacts. Table CH4-1 presents a summary of impacts.

MITIGATION GUIDELINES

Reclamation

In order to meet the requirements of SMCRA in regard to land reclamation, the measures outlined herein would be incorporated into the reclamation plan. Those measures listed as descretionary would not be required, but if adopted would aid in establishment of vegetative cover. These measures would: (1) reduce the time required for successful reclamation to about 15 years, (2) establish an approximate natural vegetative species composition for use by livestock and wildlife, (3) establish a more dense vegetative cover which would reduce wind and water erosion, and (4) provide for the protection of reclaimed areas from grazing until desired vegetative cover is established.

Since successful reclamation has not been fully demonstrated on the existing coal mines in the ES region, it is proposed that demonstration areas be established. These areas would be established on selected sites on existing mines where reclamation procedures are being applied. These areas would be used to verify whether or not the reclamation measures listed below would result in reclamation meeting the SMCRA standards (see Chapter 8).

Proposed Measures

1. Unsuitable overburden shall be separated, stored, and buried beneath suitable overburden. All unsuitable overburden or toxic material shall be buried 6 to 8 feet or more.
2. All topsoil material will be replaced to an average depth of 12 inches or more.
3. All seedbed preparations, beginning with topsoil replacement, seeding, planting, and all conservation practices initiated will be done on the contour.
4. Contour terraces or other soil and water conservation structures will be constructed on all slopes recommended by, and to the specifications and design of the appropriate agency.
5. Snow fence panels (5 to 6 feet in length and 3 feet high) or bales of hay set on the cut edge will be placed perpendicular to the prevailing wind at random intervals over reclaimed areas having 3% or less slopes. Placement of snow catchment structures will not be less than 60 per acre. After bales have been in place through two winters, they will be used as mulch in newly reclaimed areas.
6. Application of mulching materials to seeded areas will be done at the minimum rate of 2 tons per acre (native hay or straw). Native hay or straw used as mulch or for snow catchment must be certified as noxious weed free.
7. All mulch material will be anchored to the ground by crimping with a notched coulter to a depth of 5 inches or more or covering with a suitable netting material except slopes where steepness is prohibitive (see measure 12).
8. All drill seeding will be done with a rangeland drill with depth bands attached. All seeding will be at a minimum rate of 13 to 15 pounds of pure live seed (PLS) per acre.
9. Recommended seed mixture and seeding ratio (pounds PLS/acre) is shown on Table CH4-2.
10. All seeding shall be done when soil conditions permits after October 1st and before April 30th.
11. Open areas between contour furrows or contour terraces on south and west facing slopes will be planted with seed mixture only and not receive potted shrubs.
12. All areas that are too steep to be seeded by a rangeland drill will be seeded by broadcast method at a rate of 1½ times the drill seeding rate and the mulch manually applied and anchored with a netting, wire mesh, or other suitable material.
13. Planting of potted shrubs will be done in a random manner in accordance with Table CH4-3.
14. Planting of potted shrubs will be done in spring as soon as soil conditions permit (frost free period prior to April 30th).
15. All potted shrubs will be watered while the plant is being planted with an amount to saturate the planting root zone to avoid root dehydration and insure soil-root contact. Minimum application will be 1 gallon per plant.

Table CH 4-1

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Climate	N/A*	N/A	N/A	N/A	N/A
Air Quality					
AQ-1	N/A	N/A	N/A	N/A	All
AQ-2	N/A	N/A	N/A	N/A	All
AQ-3	N/A	N/A	N/A	N/A	All
Geology					
Paleontology					
GE-1	N/A	N/A	N/A	N/A	All

*N/A - No portions of SMCRA or other regulations apply to the specific impact; therefore, other columns on table do not apply.

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Topography					
TO-1	30 CFR 715.14	N/A	Grading and contouring in reclamation plan	Area would be returned to original topography	None
TO-2	30 CFR 715.14(d)	N/A	N/A	N/A	Small depressions would be left
Soils					
SO-1	N/A	N/A	N/A	N/A	All
SO-2	30 CFR 715.16	3041 & 211	None	Post-mining potential soil productivity levels equal to premining levels	Soil productivity would be lost on disturbed lands until reclaimed
SO-3	30 CFR 715.13 30 CFR 715.14 30 CFR 715.16 30 CFR 715.20	3041 & 211	Revise reclamation plan to provide for reductions in erosional rates	An estimated 75% reduction in erosional rates	An estimated 25% of erosional losses would con-
SO-4	N/A	Mining and reclamation plan and EPA	None	An estimated 50% reduction in fugitive dust (soil loss) from haul road	An estimated 50% of haul road dust would remain as residual

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Soils (continued)					
SO-5	30 CFR 715.14 30 CFR 715.16(a) 30 CFR 715.16(c)	3041 & 211	None	An estimated 75% reduction of erosion on topsoil storage areas	An estimated 25% residual erosion on topsoil storage areas would remain.
SO-6	30 CFR 715.14(j)	3041 & 211	Revise reclamation plan to bury all contaminated soils	Burial of contaminated soil would be 100% effective	None
SO-7	30 CFR 715.14 30 CFR 715.14(i)	3041 & 211	Revise reclamation plan to miminize rill and initial gully erosion	An estimated 75% reduction in in erosional rates	An estimated 25% residual erosion soil losses would continue
SO-8	30 CFR 715.14(j)	3041 & 211	Revise mining and reclamation plan for separation and burial of unsuitable overburden material beneath suitable overburden material; submit overburden analysis data.	Separation and burial of unsuitable overburden material as well as mixing of possible toxic material would be 100% effective.	None

Table CH 4-1

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Water Resources					
WR-1	N/A	State of Wyoming	Need permits	No change	0.4% increase in use
WR-2	30 CFR 715.17(j)	State of Wyoming	Operator must replace water supply	Would alleviate impact	None
WR-3	30 CFR 715.17(j)	State of Wyoming	Replacement or rebuilding of facility	Would alleviate impact	None
WR-4	30 CFR 715.15 (a,i) 30 CFR 715.17		Waste disposal must be on property; must minimize contamination	Would alleviate impact	None
Vegetation					
VG-1	N/A	N/A	N/A	N/A	Loss of native vegetation on 8,446 acres
VG-2	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 & 211	Revise reclamation plan to provide for establishment of vegetative cover of native species in a timely manner	Reduce time of establishment of vegetative cover of native species by 25 to 30 years	Loss of native vegetative cover for 10 to 15 year period
VG-3	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 & 211	Revise reclamation plan to provide for control of grazing to promote establishment of vegetative cover in a timely manner.	Reduce time of establishment of vegetative cover and recovery of productivity levels by 25 to 30 years.	Loss of native vegetation and productivity for 10 to 15 year period

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibility	Residual Impact
Vegetation (continued)					
VG-4	N/A	N/A	N/A	Control of haul road dust and fugitive coal dust would be 50% effective	Palatability of vegetation would be affected for life of the mine
VG-5	None	State of Wyoming	Revision of reclamation plan to provide for control of noxious weeds.	Noxious weeds would be controlled	None
VG-6	N/A	N/A	N/A	N/A	Loss of native vegetation on 249 acres

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Fish and Wildlife					
WL-1	N/A	N/A	N/A	N/A	Loss of 8,446 acres of wild-life habitat
1a					Loss of 3,200 pronghorns on 8,446 acres
1b					Loss of 11,143 sage grouse on 10,586 acres

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Cultural Resources					
CR-1	N/A	106 Compliance	N/A	Subsurface cultural material could be lost since it would not be identified prior to surface disturbing activities	Loss of some cultural material
Visual Resources					
VR-1	30 CFR 715.13 30 CFR 715.20 30 CFR 715.14	N/A	Recontouring revegetation	Could be returned to existing visual class	None

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Recreation Resources					
RE-1	N/A	N/A	N/A	There are no regulations or mitigation concerned primarily with recreation. However, if reclamation for wildlife species was successful, the hunting aspects of recreation should be improved.	All
Agriculture					
AG-1	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 & 211	Revise reclamation plan to provide for establishment of vegetative cover of native species in a timely manner	Reduce time of establishing suitable sheep range by 25 to 30 years	Loss of sheep range for a 10 to 15 year period
1a	N/A	N/A	N/A	Reduce grazing loss from 40,140 AUMs to 20,000 AUMs	Loss of 20,000 AUMs of grazing
AG-2	30 CFR 715.13(a) 30 CFR 715.13(c)	3041 & 211	N/A	Three stockwater ponds would be replaced	Loss of use of stockwater reservoirs during mining and reclamation

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Mineral Resources					
MR-1	N/A	N/A	N/A	N/A	All
Land Use Planning	N/A	N/A	N/A	N/A	None
Socioeconomics					
SE-1	N/A	N/A	N/A	N/A	All
SE-2	N/A	N/A	N/A	N/A	All
SE-3	N/A	N/A	N/A	N/A	All
SE-4	N/A	N/A	N/A	N/A	All
SE-5	N/A	N/A	N/A	N/A	All
SE-6	N/A	N/A	N/A	N/A	All
SE-7	N/A	N/A	N/A	N/A	All
SE-8	N/A	N/A	N/A	N/A	All

Table CH 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Socioeconomics (continued)					
SE-9	N/A	Mine Health and Saftey Act of 1969, as ammended	N/A	N/A	Unknown
SE-10	N/A	Mine Health and Safety Act of 1969, as ammended	N/A	N/A	Unknown
SE-11	N/A	N/A	N/A	N/A	All
SE-12	N/A	N/A	N/A	N/A	All
SE-13	N/A	N/A	N/A	N/A	All
SE-14	N/A	N/A	N/A	N/A	All

Table CH4-2

RECOMMENDED SEED MIXTURE

Species Name	Ratio of seeding
Rosana western wheatgrass	3 to 4 pounds PLS/acre
Sodar streambank wheatgrass	1 to 2 pounds PLS/acre
Indian ricegrass	1 to 2 pounds PLS/acre
Bluebunch wheatgrass	1 to 2 pounds PLS/acre
Critana thickspike wheatgrass	1 to 2 pounds PLS/acre
Sweetclover	0.5 to 1 pounds PLS/acre
Four-wing saltbush	2 to 3 pounds PLS/acre
Winterfat	1 to 2 pounds PLS/acre

Table CH4-3

SHRUB PLANTING DENSITIES

Plant Species	Level Areas	Aspect along terraces, contours, catchment basins special areas *	North and East Slopes		
			Upper Third	Mid Third	Lower Third
Big Sagebrush	250**	350	250	300	400
Bitterbrush	200	150	200	150	---
Little Rabbitbrush	100	100	100	75	---

* Special areas may include constructed draws, swales, leeward side of snow catching structures

** Planting rate is number of potted shrubs per acre.

A water soluable fertilizer-root stimulant shall be added at the manufacturer's recommended rate to the water used for shrub plantings. This additive would increase survival rate and increase growth vigor of the planted shrubs.

16. Shrub planting along contour furrows or contour terraces shall be of a width extending 1 foot above and 2 feet below the furrow or terrace.

17. All topsoil storage piles will be seeded with sodar streambank wheatgrass at the rate of 12 pounds pure live seed (PLS) per acre and a cover crop of fall rye (biennial plant) at a rate of 10 pounds PLS per acre.

18. All reclaimed areas will be fenced in a manner that would exclude livestock and pronghorn and not be a hazard to wildlife.

19. Where possible, all utiligy lines should be buried underground. This would significantly reduce vertical intrusions on the landscape.

20. All buildings, power line poles, conveyors, and any other type structures should be painted earth tone colors so they would blend into the landscape.

Discretionary Measures

1. On selected areas, in lieu of potted shrubs, plugs with native vegetation could be placed with a minimum spacing of 3 to 7 per acre. Plugs would be 5 feet by 5 feet in size with a minimum depth of 3 feet. Plugs will be removed from areas planned to be stripped of topsoil. All plugging will be done during the months of February through May. Other times and methods of planting may be done with prior approval of the managing agency.

2. All seed would be prilled to aid in seed distribution and germination.

3. All seed would be treated with a repellant to prevent seed damage by rodents or birds.

4. In areas where rodent populations inhibit reclamation efforts, control measures would be initated to control the rodent population.

IMPACTS

Only those impacts to which mitigation or regulations apply are discussed.

Topography

Impact TO-1; mining operations would change the existing topographic features and drainage patterns. SMCRA regulations 30 CFR 715.14 require that the area be returned to the approximate original contour. With a properly designed grading and backfilling plan this could be accomplished on the Cherokee site. If this was accomplished, there would be no residual impact.

Soils

Impact SO-2; loss of soil productivity on 8,695 acres would occur. SMCRA 30 CFR 715.16 requires that topsoil material be removed, stored, and redistributed on disturbed areas to retain soil productivity and enhance reclamation. With the application of SMCRA 30 CFR regulations, it is estimated that the potential soil productivity levels (post mining) would be equal to the premining levels. Soil productivity would be lost on 8,245 acres during the time from disturbance until reclamation is successful.

Impact SO-3; increased soil loss would occur due to wind and water erosion on disturbed areas (8,245 acres). SMCRA 30 CFR 715.13, 715.14, 715.16, and 715.20 require that all disturbed areas be restored in a timely manner, conforming closely to original contour, with salvage of topsoil and establishment of a diverse and permanent vegetative cover of species native to the area. The application of SMCRA 30 CFR regulations would reduce the erosional rates on reclaimed areas by an estimated 75%. An estimated 25% of erosional losses would still occur.

Impact SO-5; increased wind and water erosion would occur on topsoil stockpiles and overburden spoil piles. SMCRA 30 CFR 715.14, 715.16(c), 715.16 (a.1) require the topsoil piles be located as to minimize erosion. Measures to control erosion from overburden piles shall be specified by the regulatory authority. The application of SMCRA 30 CFR regulations would reduce erosion from topsoil storage areas by an estimated 75%. An estimated 25% of erosion would still occur. An indeterminate amount of erosion would occur off of overburden spoil piles.

Impact SO-6; toxic substances would contaminate soil profiles around mine facilities. SMCRA 30 CFR 715.14(j) requires all toxic or waste material be buried a minimum of 4 feet and/or treated to neutralize toxicity. The application of SMCRA 30 CFR regulations would control the impact 100%.

Impact SO-7; alteration of topography, slopes, and drainage patterns would result in increased water erosion. SMCRA 30 CFR 715.14 and 715.14(i) require backfilling and grading conform as close as possible to original contour and grading be done on the contour. Rills and gullies 9 inches or less on reclaimed areas shall be regraded and stabilized. The application of SMCRA 30 CFR regulations would reduce erosion on reclaimed areas by an estimated 75%. An estimated 25% of erosional losses would still occur.

Impact SO-8; exposure of toxic material (overburden and/or soil) would hamper revegetation efforts. SMCRA 30 CFR 715.14(j) requires all toxic or waste material be buried a minimum of 4 feet and/or treated to neutralize toxicity. The application of SMCRA 30 CFR regulation as well as the separation and burial of unsuitable overburden material beneath suitable overburden material in the mining and reclamation process would control the impact an estimated 100%.

Water Resources

Impact WR-1; mining operations could destroy stock reservoirs in the project area. SMCRA regulations 30 CFR 715.17(i) require the hydrologic system be protected. Under this regulation the stock reservoirs would have to be rebuilt or replaced, and there would be no residual impact.

Vegetation

Impact VG-2; reclamation by the seeding method would result in a longer time period to establish shrub species. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a)(1) require the establishment on all lands that have been disturbed a diverse, effective, and permanent vegetation of species native to the area and that restoration shall be in a timely manner. Under the proposed action, a diverse, effective and permanent vegetative cover is planned, but the method of establishment would be through seeding. Since it would be difficult to establish shrub species through the seeding method, it is estimated that it would take 40 years to establish satisfactory shrub cover since natural plant succession would have to occur to complete the vegetative cover establishment. Through the application of mitigating measures shown in mitigation guidelines, the time period for reclamation of vegetative cover to the desired species and composition could be reduced by 25 to 30 years. The residual impact would be the loss of the native vegetative productivity for a period of 10 to 15 years (Figure CH4-1).

Impact VG-3; grazing of young plants on reclaimed areas would delay establishment of vegetative cover during a 40 to 50 year period. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a)(2) require that restoration be carried out in a manner that encourages a prompt vegetative cover and recovery of productivity levels in a timely manner. Under the proposed action, no provisions are made for control of the use of the reclaimed areas by either domestic stock or wildlife. Grazing use of the reclaimed areas would affect vigor of young plants and cause delay in establishment of adequate vegetative cover. With the application of SMCRA regulations, a measure of fencing all reclaimed areas would have to be initiated to assure that vegetation could be established promptly without undue hinderances, which in turn would result in the recovery of productivity levels. This measure would apply solely to the control of grazing by livestock and pronghorns. The result would be to aid in reducing the time for establishment of desired vegetative cover by 25 to 30 years. The residual impact would be the loss of vegetative productivity for a period of 10 to 15 years.

Impact VG-5; noxious weeds could invade onto disturbed and reclaimed areas. The State of Wyoming Noxious Weed Law requires that weeds identified by the state as being classified as noxious will be controlled. Under the proposed action, no provisions are made for compliance with this law. Revisions of the mining and reclamation plan are needed to include measures that would result in the control of noxious weeds. When the mitigation measures are applied as required by law full control of noxious weeds should be accomplished.

Fish and Wildlife

Impact WL-1; the proposed reclamation plan would result in conversion of the present vegetative habitat to perennial grass for a period of 40 to 50 years. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(e)(4) require the reestablishment of vegetation on any disturbed areas in a timely manner, and that species selected for reclamation shall be those that will fulfill the needs of native wildlife. Under the proposed mining and reclamation plan, it is estimated that 40 to 50 years would be required before a vegetative cover similar to premining vegetation would become established, since the proposed reclamation plan does not provide for shrub species to be reseeded that are native to the project site. The proposed action would not result in reclamation to native shrub species and as a result natural succession would be required for as long as 40 to 50 years. Through the application of SMCRA regulations, the period of time required for returning the vegetation to premining composition could be reduced by 25 to 30 years. The loss of wildlife habitat under these procedures would only be for 10 to 15 years as opposed to 40 to 50 years under the proposed action.

Impacts WL-1a and 1b would be indirectly reduced under the same time frame and SMCRA regulations as are noted above in the section on Impact WL-1. Loss of habitat and loss of animals are synonymous as far as reclamation and time are concerned.

Cultural Resources

Impact CR-1; subsurface cultural material could be lost during mining since it might not be identified prior to surface disturbing activities.

The cooperative procedures between BLM and GS ("Cooperative procedures pertaining to the protection of cultural resources related to onshore mineral leasing operations exclusive of oil, gas, geothermal and oil shale") require that the Area Mining Supervisor, GS, be contacted by the operator if any subsurface cultural resources are located during mining operations. The site will be evaluated and if determined to be of National Register quality, compliance with Section 106/2b of the Historic Preservation Act of 1966 would be completed.

Visual Resources

Impact VR-1; although no portions of SMCRA apply directly to visual resources, if reclamation measures required for other resources are carried out, the visual quality could be returned to present premining levels.

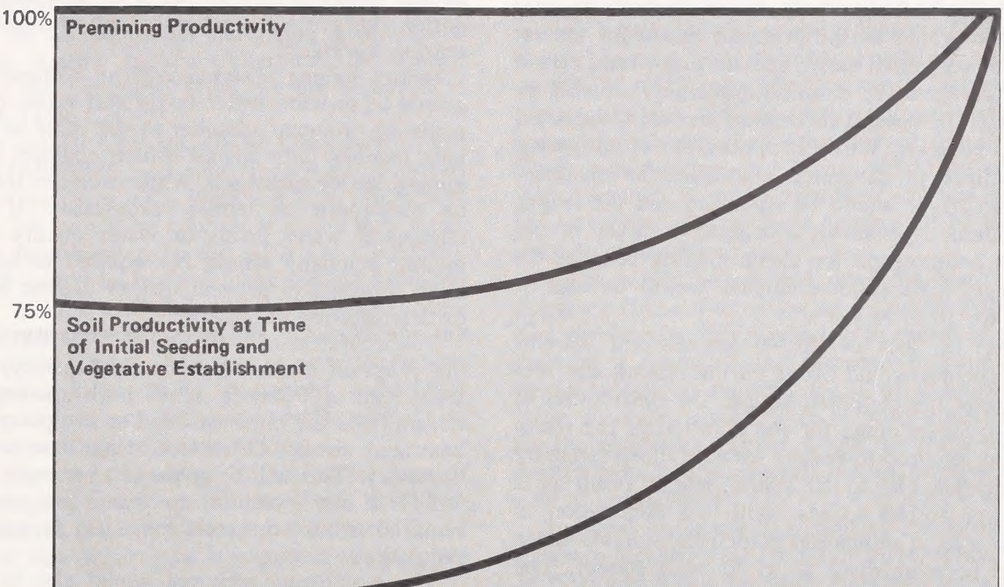


Figure CH 4-1

SOIL AND VEGETATIVE PRODUCTIVITY UNDER MEASURES REQUIRED TO MEET STANDARDS ESTABLISHED IN THE SURFACE MINING CONTROL AND RELAMATION ACT OF 1977
Cherokee

Agriculture

Impact AG-1; suitability of range for sheep grazing on 8,695 acres would be lost for 40 to 50 years. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a) provide for establishment of vegetative cover of native species in a timely manner. Under the proposed action, the reclamation measures that would be applied would result in a vegetative cover that would be marginally suitable for sheep grazing. After primary reclamation efforts, natural succession would be the principal means for the establishment of additional native species that would return the area to a vegetative composition highly suitable to sheep grazing. The natural succession process is expected to take 40 to 50 years. With the application of mitigating measures outlined in mitigation guidelines the establishment of shrub cover would be enhanced and the length of time required to establish a vegetative cover of desired species composition for sheep grazing reduced by 25 to 30 years. The residual impact would be loss of sheep range for 10 to 15 years.

Impact AG-1a; loss of 40,140 animal unit months (AUMs) of grazing would occur during mining and reclamation. Under the proposed action, the destruction of 8,695 acres of sheep range for the duration of the reclamation period required to restore suitable sheep range by natural succession (40 to 50 years) would result in a grazing loss of 40,140 AUMs. With the application of measures outlined in mitigation guidelines, suitable sheep range would be established 25 to 30 years sooner. The resulting loss of grazing would be confined to a 10 to 15 year period and would be approximately 20,000 AUMs.

Impact AG-2; three stockwater reservoirs would be destroyed. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.13(c) require that disturbed areas be restored in a timely manner and may be restored for land uses such as impoundment of water for uses such as stockwater ponds. Under the proposed action, the reclamation of improvements such as stockwater ponds is implied, but not stated specifically. Application of SMCRA regulations and revision of the reclamation plan would provide for constructing stockwater ponds that would replace those destroyed during mining. With replacement, there would be no residual impact.

Socioeconomics

Impacts SE-9 and SE-10; work related injuries and illness would occur. The Mine Health and Safety Act of 1969, as amended, regulates safety practices of coal mines. The number of injuries and illnesses that would occur even with the safety measures applied is not quantifiable.

There is no mitigation for impacts SE-1 through SE-8 and SE-11 through SE-14.

MONITORING, RESEARCH, AND STUDY PROGRAMS

Only a limited analysis could be made of impacts resulting from withdrawal of water from the deep aquifers below the mine because aquifer characteristics and movement of water between aquifers are largely unknown. The impacts do not appear significant enough to require that additional wells be drilled. However, complete aquifer tests will be required of all new wells constructed within the project area or by the company at any site outside the area.

Before mining commences, the company will be required to provide water levels and water quality data in wells on property adjacent to the mine in order to provide baseline data against which changes resulting from mining can be measured. Water levels in these wells shall be monitored as mining progresses. If a significant change in water levels or water quality develops, the mining company would be required to adjust its operation schedule to prevent further decline in water levels or deterioration of quality.

The operators will be required to provide a monitoring program to measure chemical quality, pH and sediment load of Fillmore Creek both upstream and downstream from the mine area and at any point where a concentrated stream of surface water leaves the property boundary. This will be required to comply with 30 CFR 715.17. If any violations are found the company will be required to take measures necessary to comply with the regulations.

The monitoring program would also be used to provide baseline data against which changes can be measured; therefore, monitoring would begin prior to mining. Data from such a monitoring program could be used in assessing the impacts of future mining operations.

A representative of BLM will annually inspect livestock grazing areas adjacent to mining operations to determine if such operations are affecting grazing patterns of the allotment, to determine if any range overuse is resulting from the changes in grazing patterns that may be occurring, and to determine measures to be applied to correct any overuse of the range.

As reclamation is accomplished, the compliance officer (state and federal) will conduct periodic inspections of mining areas to assure that reclamation is accomplished in accordance with an approved reclamation plan.

Reclaimed areas will be jointly inspected periodically by representatives of federal and state agencies and the operator to determine areas on which reclamation is completed and acceptable and to jointly determine corrective measures to be applied on areas where reclamation efforts have proven inadequate (e.g., seeding failure).

The proposed action would destroy three sage grouse strutting grounds or leks. In order to reduce the loss of sage grouse due to the proposed action, a research study will be initiated to investigate the possibility of moving strutting grounds to areas that would not be disturbed by mining. The study would determine in part, how far grounds can be moved, how they should be moved, and would develop criteria for moving and monitoring strutting grounds (personal communication, Robert Eng, March 1978). The study will be funded by the mining company.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

This chapter lists and quantifies adverse impacts upon the environment that would be due to implementation of the proposed action. This implementation would not cause significant or adverse impacts to all resources. Therefore, only those resource elements that would be adversely impacted are discussed in this chapter.

There will be no additional mitigating measures to reduce the air quality impacts. Therefore the annual emissions from the Cherokee Mine site are expected to be as shown in Table CH3-5.

Of the total annual total suspended particulate (TSP) emissions of 4,032; 5,486; and 5,467 tons/year generated at the mine for the years 1985, 1990, and 2020 respectively, only about 2% would be applicable to the new interim regulations implemented by the EPA (43 CFR 118). The other 98% would be fugitive dusts and are excluded from any air quality assessment. The Cherokee Mine would not be expected to exceed the NAAQS nor the Class II increment under the new review procedure. However, fugitive dusts, to be controlled under best management practices, are still the most significant in quality impacts resulting from strip mining.

Visibility is expected to average 26 to 47 miles depending on climatological conditions. During worst case fugitive dust situations, visibility could be reduced to 13 miles, however this occurrence is expected to be infrequent.

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur due to the mining process and unauthorized collecting.

The destruction of natural features of the landscape would be unavoidable. After restoration, the average elevation of the strip mined area would be about the same as present, because the expansion of the overburden would tend to compensate for the removal of the coal seam. However, the mined area would partially recompact over many years, eventually lowering the average elevation by about 20 feet. Drainage patterns would be unavoidably altered. Cuts and fills for the railroad spur and for service roads could not be restored to preexisting conditions. Regrading and filling of pits resulting from removal of clinker and gravel would not restore the original land contours.

Disturbance of existing soils on a total of 8,695 acres cannot be avoided. In the area to be mined (final contour), soil profiles, properties, and characteristics that have developed over geologic time would be destroyed on 7,623 acres. The existing soil biota and soil forming process would be drastically altered. Conventional surface strip mining would destroy approximately 283 to 166 (initial disturbance would be greater than subsequent disturbance) acres a year with a maximum of 600 to 900 acres of soil exposed at any one time.

The estimated potential soil productivity levels of reclaimed areas would be about 100% of the average premining levels. However, soil productivity would be lost during the time from disturbance until reclamation is successful (10 to 15 years after the start of reclamation).

An estimated 25% of erosional losses, both wind and water, on all disturbed areas would not be controlled. Haul road fugitive dust levels would be reduced 50% with watering. There would be a soil loss of about 0.42 ton/acre/year due to wind erosion off of exposed areas prior to reclamation.

Water would be pumped from the basal sandstone of the Fort Union Formation at a rate of 500 to 600 acre feet per year (ac ft/yr) which is in excess of the recharge rate. It is estimated that artesian pressures and water levels would be reduced for 2 or 3 miles around the mine. It would require 40 to 60 years after mining ceased for the aquifer to recover. Using the playa for disposal of wastes would cause a small risk of increased mineralization of groundwater.

Regional water use as a result of this project would be 650 acre feet per year (ac ft/yr) in 1985, and 750 ac ft/yr in 1990 and thereafter until the completion of mining in 2024. The mine would increase the water use in the region by 0.4%.

The development of the Cherokee project would result in the complete removal of 8,695 acres of native vegetation. Of this total, 249 acres would be utilized for housing and support service sites at various population centers and the loss of native vegetation would be permanent. The remaining 8,446 acres are located on or adjacent to the project area and the loss of vegetative cover would be of temporary nature since the lands would be reclaimed.

The proposed action would result in the direct removal of 8,446 acres of wildlife habitat, including 3,637 acres of pronghorn winter range. Of this winter range, 2,983 acres are crucial winter range. Losses of pronghorn habitat to mine activities would amount to less than 1% of the total available pronghorn range in the region, but would be equivalent to about 11% of the pronghorn habitat associated with the herd that uses the mine area. A total of 3,203 acres of year-round habitat for mule deer would also be destroyed by the proposed action. Mule deer range lost to the proposed mine actions would total less than 1% of the mule deer habitat in the region.

Sage grouse habitat losses would total an estimated 8,446 acres of both year-round habitat and crucial nesting cover. This acreage would amount to less than 1% of the sage grouse habitat available in the region, but would be all of the sage grouse habitat on the mine site.

In addition to the acres of habitat removed directly by mining, wildlife use of an additional 2,225 acres would be lost because of noise, dust, traffic, etc. These additional 2,225 acres would be very critical to the survival of sage grouse because this acreage is composed entirely of crucial nesting habitat around the strutting grounds on the mine site. These losses of wildlife habitat cannot be avoided if the proposed action is implemented.

The loss of an estimated 125 pronghorns (50% of the pronghorns inhabiting the area, but less than 1% of the regional population) and their progeny over the 40-year mine life would total an estimated 5,828 animals which could have been utilized by both hunters and nonconsumptive users. These losses cannot be avoided if the proposed action is implemented.

An estimated 11,143 sage grouse would be lost to all users over the period of mine life. These losses would be less than 1% of the regional population. These losses would ve unavoidable. In addition to the grouse lost over the life of the mine, unquantifiable numbers of these birds would be lost for all time since the proposed action would destroy three strutting grounds. Thus the production of grouse from the breeding grounds would be lost if the proposed action is implemented.

The effective mitigation of adverse impacts to subsurface cultural resources would depend upon several factors. These factors include; (1) successfully predicting areas of likely subsurface sites, (2) the amount of destruction which occurred to a site as it was being unearthed, and (3) the ability and willingness of workers to recognize and report cultural resources when they are discovered in the absence of a professional archeologist.

The proposed coal mining would lower the scenic quality of the landscape character of the Cherokee project area. During mining the area would be lowered from Visual Resource Management (VRM) Class III to Class V. Spoil piles, pit headwalls, coal storage, and topsoil piles would alter the landscape character. Roads, power lines, phone lines, load out area, conveyor systems, crusher facilities, and other structures would remain until removed and the site ~~is revegetated. The~~ changes to line, form, color, and texture would be obviously visible until vegetation is successfully reestablished. Changes in the landscape character would remain after revegetation, but the visual class could be returned VRM Class III after reclamation. Management objectives to maintain the quality of the VRM Class III could be met.

Recreational access would be restricted during mining in the Cherokee project area. As the mine is developed, people would come to the area to view the mining activities. Access restrictions on site would affect hunting, sightseeing, and off-road vehicle travel.

Increased population would result in increased recreational use throughout the region. This increased use would lower the quality of the existing type of outdoor recreational experience. Also, due to increased use, ranchers in the area might restrict access across their private lands. Use of urban recreation facilities in Rawlins and Wamsutter would incur the largest increase.

Table CH3-10 depicts estimated visitor use change due to the proposed coal mining. The numbers illustrate the changes in recreation use due to population increases in the region.

The removal of 250 million tons of coal would reduce Wyoming's coal reserves by about 0.47%. Dilution, caused by use of large equipment for rapid removal of overburden and coal, would result in an additional loss of 27.8 million tons of coal.

The estimated 5,100 cubic yards of sand and gravel needed for construction of mine facilities would not be recoverable at the end of mining operations.

The 119,220 cubic yards of scoria needed for railroad spur construction and road construction would not be recoverable at the end of mining operations.

The Cherokee project would cause a shortage of 48 workers in other sectors of the economy in 1985.

The Cherokee project would increase total wage earnings ($15.8 million) in the region, creating local inflationary pressures and reducing the buying power of people on fixed incomes.

This same inflationary trend would force the price of housing higher, creating crowded housing conditions and forcing people to accept housing that is not up to their expectations or desires.

An additional dentist and three registered nurses would be required by 1990.

Congestion on the local access roads would increase, especially during shift changes. Traffic delay would increase 8 minutes a day at railroad crossings along the route from the Cherokee project to the markets in the midwest. Although not quantifiable, the coal trains would increase noise and air pollution along the route.

CHAPTER 6

SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

Approval of this mining and reclamation plan would allow mining of 250 million tons of coal over a period of 40 years to meet national energy demands outside this region.

The Cherokee area is presently used for livestock grazing, wildlife habitat, and oil exploration. Coal development, if approved, would be new to the area. The area could return to premining land uses after reclamation of the site.

The short-term use of the mine site would expose or disturb over 8,000 acres of land surface over the life of the mine. The air pollution caused by the mining operations during coal extraction would be a short-term event which would cease at the end of the mine life. The largest potential threat to long-term productivity in terms of air quality would be the failure to complete reclamation of the exposed and disturbed acreage. Wind erosion could continue to generate fugitive dust emissions from the mine site if a proper vegetative cover were not established. If however, land reclamation is successful, no long-term problems from wind erosion may be expected. Since the land would be returned to grazing and wildlife forage, the long-term effects of mining should be nonexistent.

Access to the site would be limited since the access road, as well as all other roads at the mine site would be reclaimed. Emissions from vehicle traffic or wind erosion from areas exposed by the traffic at the mine site should be negligible.

Short-term use of the soil resource resulting from construction of mine facilities, ancillary facilities, relocations, and mining operations (final contour), would disrupt the productivity, destroy existing soil profiles, and increase soil erosion losses on 8,695 acres. Potential soil productivity levels over the long term would be restored on 8,245 acres to an estimated 100% of average premining levels with successful reclamation. The long-term commitment of 249 acres for urban needs would utilize the soil resource for an alternate use.

Water used at the mine and by municipalities to meet population increases resulting from the mine would not be available for other uses. At present, there is no competitive use for this water. The mine should have no permanent impact on water resources, but the water producing potential of deep aquifers could be reduced somewhat for 40 years after mining is completed.

The development of the Cherokee project would result in short-term losses of native vegetation on 8,446 acres and the loss of palatability on vegetation affected by haul road and fugitive coal dust. The productivity on the 8,446 acres would be regained within the 10 to 15 year reclamation period. The adverse affects of haul road dust and fugitive coal dust would end with the completion of mining operations. These short-term losses would be borne in order to gain the benefits received through the development of the project.

The development of 249 acres for housing and support service sites would be a conversion of land use for the long term from lands supporting vegetative cover to land supporting housing and business enterprises. Productivity in relation to vegetation would be lost, but productivity as measured in benefits to other catagories, such as people, would be enhanced for the long term.

In the short term there would be: loss of all wildlife habitat (8,446 acres) inside the final contour, plus habitat not disturbed but rendered unavailable (2,225 acres) by mine related activities, but within the project boundary; the loss of an estimated 5,828 pronghorns; and the loss of an estimated 11,143 sage grouse.

There would also be heavy losses, that are not quantifiable, of small rodents, cottontail rabbits, small songbirds, mourning doves, and reptiles over the 8,446 acres. Approximately ten mule deer would be displaced into adjacent areas.

A long-term commitment of cultural resources would result from the destruction of sites. If all sites were left in situ, more information could possibly be extracted from the site by improved techniques in the future. Due to proposed mining at Cherokee, the intensive cultural inventory for this area has been greatly accelerated.

Short-term (to 1990) improvements to Class V areas could be achieved when mined areas are reclaimed. Long-term (1991 to 2034) improvement would be achieved by reclamation and natural plant succession; removal of mine equipment, rail spur, and power lines; and restoration of waste disposal areas. The area could be reclaimed to a Class III.

Development of the proposed mine would change the nature of the primary recreational activity (hunting), since most of the reclaimed areas would not be suitable for wildlife habitat for a long period of time. As human activity increases at the mine, disturbance to all recreation activities would occur in the short term, owing to the loss of the recreation land base. In the long term, recreation use on the area could resume with removal of mining equipment, successful reclamation, and reestablishment of wildlife species.

A short-term trend would be the tendency for recreational visitors to go elsewhere in the region, thus im-

pacting other areas. This trend could reverse in the long term.

The destruction of 8,446 acres of vegetation would result in a cumulative loss of approximately 20,000 animal unit months (AUMs) of grazing or an average of approximately 400 AUMs annually. These AUMs would be foregone to permit the development of the mine facilities and mine in order to recover the mineral reserve.

The major trade-off in mineral resources would be between the short-term use of the coal, sand, gravel, scoria, oil, and diesel fuel and the long-term availability of these resources.

In the short-term, the increased employment at the Cherokee project would create labor shortages in othe regional sectors of the economy. In the long term, as more people move into the region, a labor force of sufficient size to meet the needs of all employers would be available. In addition, this increased employment would tend to hold the unemployment rate at its current low level.

Increased wage earnings would in turn increase retail and wholesale trade over the life of the mine. This would be a short-term gain while the loss of buying power of people on fixed incomes would be long term.

In the short term, housing prices would rise and crowded conditions would occur. However, over the long term the housing stock would increase, allowing such crowded conditions to subside.

Health care in this region may never be considered up to standard, but over the long term the population/health care specialist ratios would return to at least the current levels. Impacts directly associated with mining of coal (congestion on access roads, traffic delay at railroad crossings, air and noise pollution) would be short term in nature and would disappear when the mining ceases at the project.

Work-related injuries and illness would be short-term losses due to the proposed action. Those injuries or illnesses which are fatal or debilitating would reduce long-term human productivity.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Implementation of the project would result in commitments to use the area more intensively and would significantly alter the use of various resources. The use and consumption of land and resources would be irreversible (once initiated, use and impacts would continue and could not be reversed for a long time, if at all) or irretrievable (irrecoverable for a long period of time or permanently). Irreversible refers to trends; irretrievable refers to loss of resources for other uses. Some commitments are both irreversible and irretrievable.

Soils, vegetation, wildlife, and present land use on the proposed project area would be irreversibly committed during the life of the project and thereafter until reclaimed or reestablished. Air and water would be irreversibly committed during the life of the project to the extent that air quality would be degraded and water used by the project would not be available for other uses. A major irretrievable commitment would be the loss of 250 million tons of coal, which would be permanently lost and therefore not available to future generations. Cultural values, construction materials, fuels, and any loss of human life would also be irretrievable if the project should be implemented.

This chapter summarizes and quantifies where possible these types of resource commitments for the entire project to provide a total picture of what implementation of the project would involve.

An irretrievable commitment of an undetermined number of uninventoried exposed and unexposed fossil localities would result from mining, as well as an increase in unauthorized fossil collecting. The destruction resulting to the resources would be an irretrievable commitment.

Changes in contours and surface characteristics would irreversibly alter the wind field and surface heating of the air. Changes in the composition of topsoil and vegetation could alter the specific heat of the surface material, which in turn would alter the absorption and radiation of solar heat. Changes in contour may also irreversibly alter the wind field and the surface heating of the air. Though these potential climatological changes are irreversible, their adverse impact, if any, will be very minimal and in all likelihood unnoticable, and contained within the mine site.

The destruction of existing soil profiles on 8,695 acres by mining, mining facilities, ancillary facilities, and associated urban needs would be an irretrievable utilization of soil resource. The erosional loss of soil (unquantifiable) caused by mining activities as well as the soil surface disruption caused by increased activity would be an irretrievable utilization of the soil resource.

The proposed mine and related population increases would require 650 acre feet per year (ac ft/yr) by 1985, and 750 ac ft/yr by 1990 and thereafter until 2024. During these time periods, the water would not be available for other uses; however, the aquifers would recharge in 40 to 60 years.

The development of housing and support service facilities on 249 acres at various population centers in the region would be an irreversible and irretrievable commitment of the native vegetative cover on these acres to facilities of higher use.

The destruction of the three strutting grounds or leks would result in the total loss of the sage grouse population on and immediately adjacent to the project area. Physical destruction of a strutting ground will result in the complete loss of the population associated with that breeding complex within a period of 3 years (personal communication, Clait Braun, March 1978).

The destruction of sites would be an irreversible and irretrievable commitment of the resource.

Because of soil variations, slopes, and climate, vegetative reclamation scars would be evident on the project area. However, the area could be returned to a Class III. However, the area could be returned to a Class III.

The coal related population increases would impact recreational activities (especially urban). Although some of the coal related population would leave once mining was completed, the regional population increase would cause an irreversible impact on recreation resources.

The Cherokee project would irreversibly reduce the buying power of people on fixed incomes. The buying power they lose during times of inflation would never be regained.

Fatal or debilitating injuries and illnesses would be an irreplaceable loss of the human resource.

Community expansion would lead to an irreversible change in land use from rangeland to residential around and near those communities receiving additional population from this mine.

CHAPTER 8

ALTERNATIVES

The Geological Survey (GS) has accepted the Cherokee Mining and Reclamation Plan as adequate for environmental review and consideration for subsequent approval under 30 CFR 211 regulations as of May, 1976. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing law and regulations. He may also defer decision pending submission of additional data, completion of required studies or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary. The regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technologic improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO-ACTION ALTERNATIVE

No action on mining proposals for the initial development of existing federal leases would result in maintaining the status quo on those leases. Without approval of the mining and reclamation plan the Cherokee project as proposed would be abandoned. In the instance of the land use permits, there are no alternate routes available that would not involve public lands; therefore, non-approval of the land use permits would make it impossible to develop the mining project. Without the approval of the mining and reclamation plan, the development of the mine would not be economically feasible since federally owned coal would be needed to mine in an orderly and economically sound basis.

Specific markets have not been identified for the 250 million tons of coal (6 million tons per year) from the proposed Cherokee Mine. If this coal is not mined, the anticipated Midwest markets would have to find an alternate source of low sulfur coal.

If the Cherokee project area is not mined, impacts as projected in Chapters 3, 5, 6, and 7 would not occur.

Population declines lead to many adverse effects such as excessive housing vacancies, community facilities which are greatly over capacity, excessive private investment (in businesses which can no longer remain solvent, in homes which may decline in value, etc.), and higher taxes to pay for more facilities than are needed. It appears inevitable that such effects would eventually occur (the available coal and uranium would eventually be exhausted), but these effects would not occur prior to 1990 and would not be "triggered"by rejection of the mining and reclamation plan.

CONDITIONAL APPROVAL TO DEMONSTRATE SUCCESSFUL RECLAMATION

To meet the requirements of SMCRA, the company would have to submit a revised mining and reclamation plan which incorporates detailed provisions for reclamation. The mining and reclamation plan would be conditionally approved for a period of 10 years during which time a specific testing and monitoring program for the purpose of measuring revegetation success would be implemented by the coal mining company. In this alternative a plan describing the testing and monitoring program would be prepared by the Pacific Power and Light Company for approval by the regulatory authorities prior to its implementation.

If it cannot be demonstrated that revegetation can be successful commensurate with Public Law 95-87 (SMCRA) at the conclusion of the 10-year program, the Department of the Interior will revoke its approval for mining on federal lands.

Although current reclamation research indicates that successful reclamation can be achieved on semiarid coal mined lands, it is recognized that answers to reclamation problems are needed on a site-specific basis in order to ensure success.

This alternative, if implemented, would result in the gathering of data to show that lands proposed for mining are reclaimable within a reasonable period of time (10-15 years after reclamation is initiated).

The Pacific Power and Light Company would be required, under the direction of state and federal reclamation regulatory and surface ownership agencies, to establish a suitable number of demonstration plots to provide evidence of revegetation success.

The demonstration plots would be established as soon as practicable following the authorization of the Department of the Interior to commence mining operations.

Impacts which would occur if revegetation could not be accomplished follows:

1. The mining company would be forced to shut down its operation on federal land.

2. A shut down of the mine would cause economic loss to the mining company from the sale of coal, loss of employment for most of the employees, and partial loss of investment in equipment and material needed to open and operate the mine for the 10-year period.

3. Areas disturbed (about 3,500 acres) during the 10-year period of mining would be unreclaimed or at best only partially reclaimed.

4. The consumer of coal from the mine would need to obtain coal from another source.

5. The reduction in labor force would cause socioeconomic impacts to the region.

DEFER ACTION

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan. This could include, but is not limited to, the need and time required for the redesign of the mine plan to reduce or avoid specific environmental impacts addressed under the Fish and Wildlife Mitigation Alternative, Visual Resources Alternative, the alternative for air quality, and the alternative of conditional approval pending demonstration of successful reclamation.

PREVENT DEVELOPMENT ON THE LEASE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different designed course of action by the lessee (operator). This may be accomplished by suspension of operation (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. Any of these would have the effect of precluding development.

If prevention of development of the existing lease were accomplished, substantial quantities of coal known to be present would be left in place and not recovered for use. To replace the resource foregone by this alternative course of action, other comparable quantities of coal would be required to substitute in the marketplace for this supply. Other impacts are described under the No Action Alternative.

RESTRICT DEVELOPMENT ON THE LEASE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc.

Depending upon the extent to which development is restricted, the impacts would be similar to those described for the No Action Alternative.

APPROVE THIS MINING PLAN AFTER MODIFICATION

A number of the impacts identified and described in Chapter 3 of this statement could be more fully mitigated by the selective application of those measures described below that are supplemental to the proposed action described in Chapter 1. They follow the best management practices recommended by the Environmental Protection Agency in comments provided on the Southwestern Wyoming Regional Coal ES. The measures to reduce impacts are analyzed here as an alternative, but will probably be adopted as required measures in the final environmental statement and the impact analysis modified accordingly.

Best Management Practice Air Quality Alternative

A number of the impacts identified and described in Chapter 3 of this statement could be more fully mitigated by implementation of one or more of the alternatives described below. In addition, special conditions could be added to the approved plans relating to the secondary effects of mining.

Haul and access roads would be the two largest sources of fugitive particulate emissions at the proposed Cherokee Mine site. Chemically stabilizing the haul roads and paving the access road are two alternatives which would effectively control a significant portion of the fugitive emissions generated by these sources. Chemical stabilization of the haul roads would generally control 50% to 75% of haul road emissions and paving would be 85% effective in controlling emissions from the access road. Wind erosion from these sources would also be significantly reduced. Other possible alternatives not chosen for the access road are chemical stabilization and watering of the access road during shift changes since lower control efficiencies would be realized as opposed to paving.

Wind erosion from other exposed areas and dragline and topsoil removal operations would also be significant sources of fugitive dust however, these emissions cannot practically be controlled. Another significant source of fugitive dust emissions would be open storage of the raw

coal prior to washing operations. The use of enclosed storage could essentially eliminate emissions from this source.

Table CH8-1 shows the total annual emissions for each study year as was presented in Chapter 3, the total deduction in annual emissions that would result from the above alternatives, and the total annual emissions expected if the above alternatives were employed. An average control effectiveness of 62.5% for chemical stabilization was used in making the calculations.

The reduction in annual emissions would result in a lessening of air quality impact. The annual and 24-hour worst case predicted and resulting TSP isopleth analyses that would be expected for each study year if the alternatives were employed are on file with the Rawlins District Office of the BLM.

The use of the alternatives would have no effect on reducing gaseous emissions from mine vehicles. However, even without a reduction in sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), or hydrocarbons (HC) emissions, no significant air quality impact would be predicted. Present levels of these pollutants are far below the standards and only insignificant amounts of these pollutants would be released from vehicles at the mine site.

Visibility at the mine site and near the access road would be improved by the reduction in fugitive dust. Visibility during the worst 24-hour case is not expected to fall below 17 miles near the mine site as opposed to 13 miles as predicted without the alternatives (Chapter 3). For the most part, visibility would be expected to average 26 to 47 miles depending on climatological conditions such as fog, rain, and snow.

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decisionmaker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects on vegetation, soils, wildlife, etc., by reducing the area in which the impacting activities could take place. However, implementation of this alternative would not permit maximum recovery of the coal resources.

FISH AND WILDLIFE MITIGATION ALTERNATIVE

This alternative lists recommendations which, if implemented, would greatly reduce or totally eliminate the major impacts to existing wildlife resources described in Chapters 3 and 5 through 7 by enhancement of the wildlife habitat and carrying capacities of those lands adjacent to the proposed mining operations or on nearby off site locations.

Recommendations

1. That all mining areas be reclaimed to include wildlife habitat (Tables CH4-2 and CH4-3) as soon as possible. Reclamation would be in conformance with the post-mining land use set out in BLM's land use plans for the area. Vegetative planting and reclamation should be accomplished in consultation with the Wyoming Game and Fish Department, Wyoming Department of Environmental Quality, and U.S. Fish and Wildlife Service. The goal of reclamation should be to achieve the highest possible wildlife carrying capacity at the earliest possible date using all possible tools to achieve this goal.
2. That approximately 1,700 acres or an acreage deemed necessary to compensate the impacts be set aside as a mitigation area. This mitigation area would be made up of land lying in immediate association with the proposed Cherokee mining area or on nearby off site locations and managed intensively for wildlife resources. Selection of this mitigation area should be accomplished in consultation with the Wyoming Game and Fish Department and U.S. Fish and Wildlife Service.
3. That the mitigation area be managed to increase its wildlife carrying capacity by at least 50% or the amount necessary to compensate impacts. Management tools such as water development, fertilization, vegetative manipulation, spraying, transplanting, seeding, protection of wildlife cover, and management of livestock grazing to enhance wildlife habitat should be implemented as necessary. The habitat of these mitigation areas should be managed by BLM and the wildife by the Wyoming Game and Fish Department.
4. The mine permits will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for substitute mining practices, buffer zones, prey base, and alternate nest sites.

Environmental Recommendations

1. All disturbed areas scheduled to be reclaimed should include the following browse species in the seeding mix; winterfat, fourwing saltbush, and little rabbitbrush. Seeding rates of these species should follow recommendations in Plummer et al. (1968).

Table CH8-1

TOTAL ANNUAL EMISSIONS FOR EACH STUDY YEAR WITH CHEMICAL STABILIZATION OF HAUL ROADS, PAVED ACCESS ROAD, AND ENCLOSED COAL STORAGE

Study Year	Annual Chapter 3 TSP emissions (tons/year)	Total best management practice TSP emissions (tons/year)	Expected emission reductions (tons/year)	Expected reduction in emissions (%)
1985	4,031	1,229	2,802	70
1990	5,467	2,239	3,228	59
2020	5,456	2,099	3,357	62

2. Potted shrubs should be established in clusters behind snow fences so that protection and additional moisture afforded by the snow would increase the likelihood of shrub cover being quickly established.

3. The two sage grouse strutting grounds, located on the Cherokee site should be moved using techniques now being developed on coal mine areas in southern Montana (personal communication, Eng 1978).

4. The strutting ground located on the playa east of the project area should also be moved as mentioned above, since the company proposes to use the playa for a settling pond. An alternative to moving this ground would be to dewater the fine reject at the plant (Cherokee Mining and Reclamation Plan 1976) and not utilize the playa for a settling pond.

Should this alternative be initiated, impacts that would occur on the project area to other resources would be identical to those identified under the proposed action.

CHAPTER 9

CONSULTATION AND COORDINATION

See the Regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in preparation of the draft ES.

CHEROKEE APPENDIX

SOIL MAPPING UNITS

37-Fleutsch fine sandy loam, 0% to 3% slopes

This unit consists of soils occupying nearly level alluvial fans of 0% to 3% slopes. The profile of this series is similar to the representative pedon description. Included within this soil mapping unit are small areas of Rock River and Cushool. They occur on the upper slope areas and make up less than 15% of the unit.

Typically, the surface layer is light brownish gray loamy sand about 2 inches thick. The subsoil is usually about 24 inches thick. The upper part of the subsoil is a yellowish brown fine sandy loam; the lower part is a yellowish brown gravelly fine sandy loam. The substratum, to a depth of 60 inches is a light brownish gray calcareous loamy fine sand.

202-Tasselman-Shinbara complex, 6% to 30% slopes

This complex consists of about 50% Tasselman sandy loam, 10% to 30% slopes, and about 25% Shinbara loam, 10% to 30% slopes. The profiles of these soils are similar to the typical profile described as being representative of each series. The complex occupies moderately to steeply sloping planed landscapes. The landscapes occur over the dip slope of the underlying sandstone formations and are incised by a few bedrock controlled drainages and gullies. The Tasselman and Shinbara soils are intermingled on the landscape surfaces. The areas occupied by the individual soils are determined primarily by the characteristics of the underlying bedrock. Included are areas of soil that contain more than 50% channery, areas of sandstone ledge rock and small hummocks of wind deposited sandy loam.

Typically, the Tasselman soils have brown mildly alkaline sandy loam surface horizon about 2 inches thick. The underlying layer is yellowish brown, moderately alkaline channery sandy loam extending to hard, slabby sandstone at 10 inches.

Typically, the Shinbara soils have a brown loam surface horizon about 2 inches thick. The underlying material, about 6 inches thick, is a yellowish brown loam. Soft, gray, fractured, loose siltstone occurs at 8 inches.

207-Delphill-Blazon association, 6% to 30% slopes

This mapping unit consists of gently sloping to sloping upland ridges and sideslopes. The association consists of about 40% Delphill loam, on sideslopes and foot slopes of 6% to 20%. The Blazon soils occur on ridge crests and upper sideslopes (10% to 30% slopes) and make up about 30% of this unit. Included in this mapping unit are about 30% Rock outcrop, Patent, Forelle, Shinbara and moderately deep sandy soils.

210-Ravalli-Forelle-15 association, 0% to 6% slopes

These nearly level and gently sloping soils are on alluvial fans, terraces, and drainageways. The Ravalli soil makes up about 30% of the mapping unit, the Forelle soil about 30% and the 15 soil about 25%. The Ravalli soil differs from the Forelle and 15 soils by having a higher sodium content in the subsoil. The Forelle soil differs from the 15 soil by having a distinct clay accumulation in the subsoil. Included in this mapping unit are about 15% Bullock and Rock River soils.

Typically, the surface layer of the Ravalli soil is a yellowish brown, mildly alkaline sandy loam about 2 inches thick. The upper part of the subsoil is yellowish brown, moderately alkaline loam about 3 inches thick. The center part of the subsoil is brown, moderately alkaline loam about 9 inches thick. The lower part of the subsoil is very pale brown, very strongly alkaline clay loam about 6 inches thick. The upper part of the substratum is pale brown, very strongly alkaline loam about 5 inches thick. The lower part of the substratum is pale brown, very strongly alkaline very fine sandy loam to 60 inches or more.

Typically, the surface layer of the Forelle soil is a grayish brown, mildly alkaline loam about 4 inches thick. The upper part of the subsoil is yellowish brown, mildly alkaline clay loam about 11 inches thick. The center part of the subsoil is yellowish brown, mildly alkaline clay loam about 14 inches thick. The lower part of the subsoil is pale brown, moderately alkaline clay loam about 16 inches thick. The substratum is pale brown, moderately alkaline loam extending to 60 inches or more.

Typically, the surface layer of the 15 soil is a pale brown, moderately alkaline loam about 2 inches thick. The subsoil is light yellowish brown, moderately alkaline loam about 6 inches thick. The upper part of the substra-

tum is pale brown, moderately alkaline loam about 37 inches thick. The lower part of the substratum is brown, moderately alkaline sandy loam to a depth of 60 inches or more.

225-Cushool-Rock River association, 3% to 10% slopes

This association consists of about 50% Cushool sandy loam, 3% to 10% slopes, and about 30% Rock River sandy loam, 3% to 6% slopes. The soils of this association occur on rolling uplands and narrow valley slopes traversed by long, narrow, rounded ridges. The Cushool soils occur on smooth rolling uplands. The Rock River soil occupy valley slope positions leading into narrow drainages. Included are about 20% Rallod and Blazon soils on the narrow ridges, Patent soils in the narrow drainageways, and Forelle soils on valley slopes leading into drainages.

Typically, Cushool soil has a brown sandy loam surface layer about 5 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown sandy clay loam; the lower part is pale brown sandy clay loam. The underlying layer, about 4 inches thick, is pale brown sandy clay loam. Soft, pale brown, calcareous sandstone occurs at 34 inches.

Typically, the Rock River soils have a brownish gray sandy loam surface horizon about 2 inches thick. The subsoil is usually about 24 inches thick, but may range from 10 to 30 inches. The upper part of the subsoil is yellowish brown sandy clay loam; the lower part is yellowish brown sandy loam. The substratum, to a depth of 60 inches, is light brownish gray, calcareous, sandy loam. Depth to accumulations of calcium carbonates ranges from 10 to 25 inches.

231-Rock River-Cushool-Ryark association valleys

This association consists of about 40% Rock River sandy loam, 3% to 9% slopes; about 25% Cushool sandy loam, 6% to 15% slopes; and about 15% Ryark loamy sand, 3% to 6% slopes. This association occupies narrow valleys incised through sandstone uplands. The valleys are long and narrow, ranging from 1/8 to 1/4 mile in width and are uniformly sloping. The valleys generally do not have a well defined drainage channel. The Rock River soils occur on smooth alluvial fans below the upper edge of the valleys occupied by the Cushool soils. The Ryark soil occur on alluvial fans that extend up into drainages incised into sandstone ledgerock areas. In some areas the Rock River and Ryark soils are intermingled on alluvial fan surfaces. Included are about 20% Cothran soils, Red Rim soils, and soils similar to the Cothran soils with bedrock at depth of 20 to 40 inches.

Typically, the Ryark soils have a surface layer that is brown, neutral loamy sand about 4 inches thick. The subsoil is brown to yellowish brown, mildly alkaline sandy loam about 22 inches thick. The lower subsoil is yellowish brown, mildly alkaline sandy loam about 14 inches thick. The substratum is pale brown, strongly alkaline sandy loam to 60 inches or more.

232-Blazon-Delphill-Diamondville complex, 6% to 30% slopes

This complex consists of about 50% Blazon loam, 10% to 30% slopes; about 15% Delphill loam, 6% to 20% slopes; and about 15% Diamondville loam, 6% to 15% slopes. The profiles of these soils are similar to the representative profile described under the respective series heading. The landscapes occupied by the soils of this complex consist of steeply sloping ridges and narrow valleys. The ridges and valleys and associated soils from a very complex landscape and soils pattern. The Blazon soils occur on ridgecrests, the Delphill soils occur on upper sidehill slopes, and the Diamondville soils occur on lower sidehill slopes in the narrow valleys. Included are about 20% Patent, Forelle, and Shinbara soils. In addition, there are some areas of windblown fine sand and areas of bedrock exposures.

Typically, the Diamondville soils have a surface layer that is brown, neutral loam about 2 inches thick. The upper part of the subsoil is brown, mildly alkaline clay loam about 8 inches thick. The center part of the subsoil is yellowish brown, mildly alkaline clay loam about 7 inches. The lower part of the subsoil is light yellowish brown, strongly alkaline loam about 6 inches thick. The substratum is light yellowish brown, strongly alkaline loam about 9 inches thick. Soft, interbedded loamstone and sandy shales occur at 32 inches.

234-Rock River-Ryark-Cushool association, 0% to 15% slopes

This association consists of about 35% Rock River sandy loam, 0% to 6% slopes; about 25% Ryark loamy sand, 3% to 10% slopes; and about 15% Cushool sandy loam, 3% to 15% slopes. The landscapes occupied by this association consist of gently to moderately rolling uplands and gently to moderately sloping alluvial fans. The Rock River soils occupy the alluvial fan surfaces at the base of rolling areas. The Ryark soils occur on broad, rolling uplands. The Cushool soils occupy steeper uplands and sidehill slopes. One area of this association mapped along the Baggs highway differs in having a fine sand mantle of 6 to 14 inches over the normal soils. This area has received considerable fine sand blown in from adjacent areas of Cothran and Crestman soils. Included are about 25% Seaverson soils, Blazon soils, Forelle soils, Cothran soils, and areas of deep fine textured soils along the drainages on nearly level alluvial fans.

235-Blazon-Shinbara complex, 6% to 30% slopes

This complex consists of about 45% Blazon loam, 6% to 20% slopes, and about 30% Shinbara loam, 6% to 40% slopes. The soils of this complex occupy high ridges. The ridges have narrow winding crests and moderately sloping to steeply sloping sidehills. The Blazon and Shinbara soils are intermingled along the ridgecrests and sidehill slopes of the landscapes. Included are about 25% ledgerock outcrop, Delphill soils, areas of very shallow alkaline soils, and pockets of Cushool and Diamondville soils.

236-Cushool-Worfman-Blackhall complex, 6% to 30% slopes

This complex consists of about 35% Cushool sandy loam, 6% to 15% slopes; about 20% Worfman sandy loam, 6% to 20% slopes; and about 20% Blackhall sandy loam, 10% to 30% slopes. The landscapes consist of a series of spur ridges and sidehill slopes traversed by narrow drainages. The soils of the complex are highly intermingled on the ridges and sidehill slopes. Usually, the Cushool soils occupy the sidehill slope positions, and the Worfman and Blackhall soil occur intermingled on the ridges and upper sidehill slopes. Included are about 25% Rock River soils, Blazon soils and in some areas Rallod or Cothran soils.

Typically, the Worfman soils have a surface layer that is brown, neutral sandy loam about 3 inches thick. The upper subsoil is brown, mildly alkaline sandy clay loam about 7 inches thick. The lower subsoil is light brownish gray, strongly alkaline sandy clay loam about 7 inches thick. The soil is underlain by soft, calcareous sandy shales and sandstone at 17 inches.

Typically, the Blackhall soils have a surface layer that is pale brown, sandy loam about 1 inch thick. Soft, yellowish brown, calcareous, sandstone occurs at 17 inches.

237-Seaverson-Blazon complex, 3% to 15% slopes

This complex consists of about 40% Seaverson clay loam, 3% to 10% slopes, and about 30% Blazon loam, 6% to 15% slopes. This complex occupies rolling upland ridges of about 3% to 15% slopes. In some areas the ridges are fairly broad and extend from high drainage dividing landscapes downslope toward drainages. The Seaverson and Blazon soils are intermingled in the landscapes. The areas where each of these soils occur depends primarily on the underlying bedrock. The Seaverson soils form in very strongly alkaline shales or sandy shales, and the Blazon soils form in materials over loamstone. The underlying bedrocks of these landscapes are highly interbedded. Included in this mapping unit are about 30% Delphill, Diamondville, Rallod, and Abston soils.

Typically, the Seaverson soils have a surface layer that is a light olive brown, moderately alkaline clay loam about 3 inches thick. The upper underlying layer is light olive brown, very strongly alkaline clay loam about 7 inches thick. The lower underlying layer is light brownish gray very strongly alkaline clay loam extending to soft, very strongly alkaline shale at 18 inches.

238-Blanyon Variant-Bulkley-Lisam association, 3% to 20% slopes

This association consists of about 35% Blanyon, bedrock substratum variant, clay loam, 6% to 15% slopes; about 25% Bulkley clay loam, 3% to 10% slopes; and about 30% Lisam silty clay, 6% to 20% slopes. This association occurs on rolling to moderately rolling upland ridges, sidehill slopes, and footslopes. The Blanyon soils occupy sidehill slope positions. The Bulkley soils occur on the footslope positions, and the Lisam soils occupy ridgecrests. Included are about 20% Seaverson and Forelle soils as well as drainages and some shale exposures.

Typically, the Blanyon variant soils have a surface layer that is brown, mildly alkaline clay loam about 2 inches thick. The upper part of the subsoil is brown, moderately alkaline silty clay about 12 inches thick. The lower part of the subsoil is grayish brown, moderately alkaline silty clay about 7 inches thick. The substratum is light brownish gray, moderately alkaline clay loam about 5 inches thick. Soft, dark gray, gypsiferious shale occurs at 26 inches.

Typically, the Bulkley soil have a surface layer that is pale brown, moderately alkaline clay loam about 3 inches thick. The upper part of the subsoil is brown, moderately alkaline silty clay about 9 inches thick. The lower part of the subsoil is grayish brown, strongly alkaline silty clay about 16 inches thick. The substratum is grayish brown, moderately alkaline clay loam extending to depths of 60 inches or more.

Typically, the Lisam soils have a surface layer that is brown, moderately alkaline silty clay about 2 inches thick. The upper underlying layer is grayish brown, moderately alkaline silty clay about 8 inches thick. The lower underlying layer is brown, moderately alkaline silty clay about 6 inches thick. Soft, dark gray, gypsiferious shale occurs at 16 inches.

241-Diamondville-Blazon-Forelle association, 3% to 15% slopes

This association consists of about 40% Diamondville loam, 3% to 15% slopes; about 20% Blazon loam, 6% to 15% slopes; and about 20% Forelle loam, 3% to 10% slopes. This association occurs on high, hilly uplands composed of low relief rounded ridges, side slopes, and narrow valleys. The Diamondville soils occur on hillside slopes below ridgecrests. The Blazon soils occur on ridges and upper, more steeply sloping sidehills. The Forelle soils occur in narrow valleys and footslopes or

lower sidehills below the Diamondville soils. Included are about 20% Delphill soils, Seaverson soils, and thin clayey soils similar to the Lisam soils. Scattered throughout the various areas of this association are some moderately deep, fine textured soils that make up as much as 15% to 20% of some locations.

242-Blackhall-Blazon complex, 6% to 30% slopes

This complex consists of about 50% Blackhall sandy loam, 6% to 30% slopes, and about 30% Blazon loam, 10% to 30% slopes. The landscapes occupied by the soils of this complex consist of sloping ridges and steep hillsides underlain by interbedded sandstone and siltstone. The Blackhall and Blazon soils are intermingled, but generally Blackhall soils occur over sandstone, and Blazon soils occur over siltstone. Included are 20% Lisam, Delphill, and Diamondville, soils along with ledges of sandstone and shale outcrop.

245-Abston-Rallod-Seaverson complex, 3% to 30% slopes

This complex consists of about 30% Abston loam, 3% to 10% slopes; about 25% Rallod loam, 6% to 15% slopes; and about 20% Seaverson clay loam, 6% to 20% slopes. The landscapes occupied by the soils of this complex consist of rolling ridges and fairly long sidehill slopes. The soils of the complex are intermingled on the ridges and sidehill slopes. Usually, the Rallod and Seaverson soils occur on the crests of the ridges and the steeper areas, while the Abston soils occur on sidehill slopes and flatter portions of the landscaped. Included are about 25% Cushool and Diamondville soils and gravelly knobs. In some areas soils similar to the Blanyon bedrock substratum variant occur.

Typically, the Abston soils have a surface layer that is light gray, neutral loam about 2 inches thick. The upper part of the subsoil is yellowish brown, mildly alkaline clay loam about 8 inches thick. The center portion of the subsoil is light olive brown, moderately alkaline silty clay about 6 inches thick. The lower part of the subsoil is pale olive, very strongly alkaline silty clay about 8 inches thick. The substratum is light yellowish brown, strongly alkaline clay loam over sandy shale at 36 inches.

Typically, the Rallod soils have a surface layer that is light brownish gray, mildly alkaline loam about 2 inches thick. The upper part of the subsoil is brown mildly alkaline clay loam about 3 inches thick. The lower part of the subsoil is light olive brown, strongly alkaline silty clay about 5 inches thick. The substratum is light brownish gray, very strongly alkaline clay loam about 7 inches thick. Calcareous, very strongly alkaline sandy shale and shale occurs at 17 inches.

246-Cushool-Rallod-Blazon association, 6% to 30% slopes

This association consists of about 35% Cushool sandy loam, 6% to 15% slopes; about 30% Rallod loam, 6% to 20% slopes; and about 20% Blazon loam, 6% to 30% slopes. This association occurs on long, winding ridges and sidehill slopes, and long, narrow drainages. The Cushool soils occur on sidehill slopes and narrow valley positions. The Rallod and Blazon soils occur on ridgecrests and steeper slopes of the ridges. Rallod soils may generally be identified by the sparseness of the vegetation due primarily to sodic conditions. Included are about 15% Diamondville, Seaverson, Rock River, and Shinbara soils.

247-Cushool-Diamondville-Worfman complex, 3% to 15% slopes

This complex consists of about 40% Cushool sandy loam, 3% to 10% slopes; about 25% Diamondville loam, 3% to 10% slopes; and about 20% Worfman sandy loam, 6% to 15% slopes. This complex is mapped in areas where the underlying bedrock is interbedded sandstone and loamstone. The landscapes consist of low rolling hills of about 3% to 15% slope gradient. The Cushool, Diamondville, and Worfman soils are intermingled in the landscapes, depending upon the nature of the underlying bedrock. The Cushool soils generally develop over sandstone, and the Diamondville soils generally are underlain by loamstone. Included are about 15% Forelle, Rock River, Rallod, Blazon, and Seaverson soils.

248-Cothran-Crestman complex, 6% to 30% slopes

This complex consists of 50% Cothran fine sand, 6% to 20% slopes, and about 30% Crestman loamy sand, 6% to 30% slopes. The profiles of these soils are similar to the typical profile described under the series heading. The landscapes occupied by these soils consist of hilly uplands made up of upland ridges, ledges, and dune-type hummocks. The soils are highly intermingled in a very complex soil pattern. Cothran soils occur on the hummocks, and the Crestman soils occur on the ridges and ledges. Included are about 20% Blackhall soils, moderately deep soils similar to the Cothran soils with bedrock at 20 to 40 inches, and very thin soils on steep drainages.

Typically, the Cothran soils have a surface layer that is pale brown, neutral fine sand about 2 inches thick. The upper underlying layer is yellowish brown, mildly alkaline fine sand about 28 inches thick. The lower underlying layer is brown, mildly alkaline loamy sand extending to 60 inches or more.

Typically, the Crestman soils have a surface layer that is brown, moderately alkaline loamy fine sand about 3 inches thick. The upper underlying layer is pale brown, strongly alkaline loamy fine sand about 4 inches thick.

The lower underlying layer is light gray, strongly alkaline loamy fine sand about 9 inches thick. Soft, fine grained sandstone occurs at 16 inches.

249-Absher-Abston association, 0% to 6% slopes

This association consists of about 50% Absher loam, 0% to 3% slopes, and about 30% Abston loam, 3% to 6% slopes. The profiles of these soils are similar to the representative profile described for each series. The landscapes consist of low, rolling ridges on the upper side and nearly level footslopes or alluvial fans on the lower part. The Abston soils occur on low rolling ridges, and the Absher soils occur on the footslopes. But in most areas the ridges and alluvial fans are highly intermingled. Included are about 30% of Rallod, Cushool, and Rock River soils; minor drainages; and barren, alkali spots.

Typically, the Absher soils have a surface layer that is pale brown, neutral loam about 3 inches thick. The upper part of the subsoil is brown, mildly alkaline silty clay about 9 inches thick. The lower part of the subsoil is light olive brown, strongly alkaline to very strongly alkaline clay loam about 8 inches thick. The upper part of the substratum is brown, strongly alkaline clay loam about 8 inches thick. The lower part of the substratum is pale brown, strongly alkaline clay loam extending to 60 inches or more.

250-Rock River sandy loams, 3% to 9% slopes

Rock River sandy loam, 3% to 9% slopes, occupies nearly level to gently rolling elevated terraces. The profiles of this soil are very similar to the profile described as being representative of the Rock River series, except in some areas where the profile varies in having gravel at depths between 50 and 60 inches and in having strongly to very strongly alkaline reactions in the lower subsoil and substratum. The landscapes occupied by the Rock River soils are long, narrow piedmont alluvial fans that run north and south. These surfaces are about 1/8 to 3/8 mile in width and are bounded on the east and west sides by drainages. Included are areas of Cushool, Abston, and Rallod soils.

320-Monte-Clowers complex, 0% to 3% slopes

This complex consists of about 50% Monte loam, saline, 0% to 3% slopes, and about 25% Clowers loam, saline, 0% to 3% slopes. The profiles of these soils differ from the representative profile of each series in having moderate to high accumulations of soluble salts. The landscapes consist of nearly level valley-filling alluvial fans and nearly level, narrow floodplains along major drainage. The Monte soils occur on alluvial fans, and the Clowers soils occur on the floodplains. The floodplains and the alluvial fans are highly intermingled, and the soil pattern is very complex. Included are about 25% DeBone soils, Monte soils, sandy loam alluvial soils, and some wet saline areas along the streams.

Typically, the Monte soils have a surface layer that is brown, moderately alkaline loam about 3 inches thick. The upper underlying layer is brown, moderately alkaline loam about 13 inches thick. The lower underlying layer is pale brown, strongly alkaline loam extending to depth of 60 inches.

Typically, the Clowers soils have a surface layer that is moderately alkaline loam about 3 inches thick. The upper underlying layer is grayish brown, strongly alkaline loam stratified with lenses of sandy loam about 17 inches thick. The lower underlying layer is brown, strongly alkaline silt loam stratified with lenses of loam, clay loam, and sandy loam extending to depth of 60 inches or more.

401-Rockland Land Type

This land type consists of steep to very steep sandstone exposures and thin soils. The landscape is composed of about 70% sandstone ledged and associated barren shales and about 30% thin soils intermingled with rock outcrop. These landscapes are dominated by hard sandstone bedrocks and are not as highly erosive as softer bedrock areas.

CHEROKEE APPENDIX

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES)[3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH)[6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Absher	>60	Well drained	Moderately High 7.5-9.25	D	400-800	7.0-9.2	4-16	Low	4	Slow to Moderate
Abston	20-40	Well drained	Very Low 2.25-3.0	D	600-1400	7.0-9.4	2-8	Low	3	Moderate
Blackhall	10-20	Well to excessively drained	Very low 1.2-1.8	D	350-700	7.8-8.6	<2	Low	3	Rapid
Blanyon Varient	20-40	Well drained	Low 4.3-5.2	C	600-1400	7.2-8.8	<4	Moderate	4	Moderate
Blazon	10-20	Well drained	Very Low to Low 2.7-3.1	D	500-1000	7.9-9.0	2-4	Low	4L	Rapid
Bulkley	>60	Well drained	High 10.2-11.5	C	600-1200	7.8-8.8	<2-4	Moderate	4L	Moderate
Clowers	>60	Somewhat poorly drained	Moderately High 7.2-8.4	B	2000-2800	7.9-9.0	4-8	Moderate	4L	Slow
Cothran	>60	Well drained	Low 2.5-3.5	A	900-1700	7.2-8.0	<2	Moderate	1	Moderate
Crestman	10-20	Well drained	Very Low 1.4-1.8	A	700-1200	7.9-9.0	>4	Low	2	Moderate
Cushool	20-40	Well drained	Low 2.75-6.5	C	700-1500	7.0-8.6	2.0-4.0	Moderate	2	Moderate to Rapid
Delphill	20-40	Well drained	Low to Moderately High 2.0-7.25	D	800-1400	7.6-8.8	2.0-4.0	Moderate	5	Moderate to Rapid

CHEROKEE APPENDIX
(Continued)

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES)[3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH)[6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Diamondville	20-40	Well drained	Low 4.5-5.5	D	700-1500	7.0-8.8	<2.0	Moderate	6	Moderate
Fleutsch	>60	Well drained	Moderately High 7.0-8.3	B	700-1500	7.0-8.8	<2.0-4.0	Moderate	3	Slow
Forelle	>60	Well drained	High 9.25-11.75	B	500-1000	7.0-8.8	<2.0	High	5	Slow
Lisam	10-20	Well drained	Very Low 2.4-2.7	D	500-1000	8.4-8.8	2.0-8.0	Low	4	Medium to Rapid
Monte	>60	Well drained	High 9.5-11.0	B	300-800	8.0-8.6	4.0-8.0	Low to Moderate	5, 3	Slow to Medium
Rallod	10-20	Well drained	Very Low 0.8-1.0	D	500-1000	7.0-9.4	4.0-8.0	Low	3	Medium to Rapid
Ravalli	>60	Well drained	Medium --	C	400-750	7.6-9.6	<4.0	Low	5	Slow
Rock River	>60	Well drained	Moderately High 7.0-8.3	B	700-1500	6.6-9.0	<2.0-4.0	Moderate	3	Slow
Ryark	>60	Well drained	Low 3.6-4.9	B	700-1500	6.6-9.0	<2.0	Moderate	3	Slow to Medium
Seaverson	10-20	Well drained	Low 2.8-3.2	D	400-750	8.2-9.2	4.0-8.0	Low	4L	Medium to Rapid

CHEROKEE APPENDIX
(Continued)

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES)[3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH)[6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Shinbara	5-10	Somewhat excessively well drained	Very Low 0.75-2.0	D	250-600	8.2-8.8	2.0-4.0	Low	4L	Medium to Rapid
Tasselman	10	Somewhat excessively well drained	Very Low 0.98-1.60	D	700-1200	7.4-9.0	2.0-4.0	Low	3	Rapid
Worfman	10-20	Well Drained	Very Low 2.4-2.7	D	700-1200	6.6-8.5	<2.0-4.0	Low	3	Rapid
#15	>60	Well Drained	Moderately High	--	700-1200	8.0-8.4	----	Moderate	--	Medium

1. Depth of Effective Rooting Zone: Is an indicator of the depth to which plant roots would penetrate soil profile.
2. Drainage Class: Is an indication of soil profile-moisture relationships.
3. Available Water Capacity: Refers to the soil profiles potential water holding capacity for utilization by plants.
4. Hydrologic Soil Group: This grouping places soils to their potential to yield runoff; Group A being low and Group D being high.
5. Potential Production (#/ac. Dry Wt.): Refers to SCS Form 5 Potential Vegetative Production calculations from unfavorable to favorable years for each series.
6. Soil Reaction (pH): The degree of acidity or alkalinity of a soil expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: slightly acid, 6.1-6.5; neutral, 6.6-7.3; slightly alkaline, 7.4-7.8; moderately alkaline 7.9-8.4; strongly alkaline, 8.5-9.0; and very strongly alkaline, 9.1.
7. Salinity (mmhos/cm): Refers to the soluble salts in a soil, based on the electrical conductivity of the saturation extract, as expressed in millimhos per centimeter (mmhos/cm) at 25 C.

Salinity rating	mmhos/cm
Low	4
Moderate	4-8
High	8

8. Inherent Fertility: The following criteria were used for rating the soils.
   Low Soils low in available P or K, or with pH below 5.0 and above 9.0 in the A and upper B horizons, or soils having levels of moisture (A.W.H.C.), or growth of plants is severely limited.
   Moderate Soils intermediate between low and high in inherent fertility.
   High Soils high in available P and K, with pH of 5.5 or less than 8.4 in the A and upper B horizons, levels of moisture (A.W.H.C.), or alkalinity are such that choices or growth of plants are not limited.

CHEROKEE APPENDIX

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL [2]	CLASSIFICATION [3]				DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
				DEPTHS (INCHES)	USDA	UNIFIED	AASHO				
Absher	249	Fine, mortmorillonitic Borollic Natrargid	Alluvium from alkaline shales	0-36 36-60	SIC, C SIC,C, CL	CL, CH CL, CH	A-7 A-6, A-7	>60	<0.06	Low	High
Abston	245,249	Fine, montmorillonitic Borollic Natrargid	Residuum from alkaline shales	0-10 10-34	C SCL	CL CL	A-6, A-7 A-6	20-40	0.06-2.0	Low	High Moderate
Blackhall	236,242	Loamy, mixed (cal-careous), frigid, shallow Ustic Tor-riorthent	Residuum from soft sandstones	0-12 0-12	FSL,VFSL GR-VFSL	SM, SM-SC SM	A-4 A-2,A-4	10-20	0.6-2.0	Low	Low
Blanyon Varient	238	Fine, montmorillonitic Borollic Vertic Haplargid	Soft gypsiferous shales	0-2 2-21 21-26	CL SIC CL	CL CL, CH CL	A-7 A-7 A-7	20-40	0.06-2.0	Low	Moderate Low Moderate
Blazon	207,232, 235,237, 241,242, 246	Loamy, mixed (calcar-cous), frigid, shallow Ustic Torriorthent	Interbedded sand-stone, loam stone and sandy shales	0-14 0-14 0-14	CL L GR-CL	CL ML, CL-ML GM	A-6 A-4 A-6	10-20	0.2-2.0	Low	Moderate Low Moderate
Bulkley	238	Fine,montmorillonitic Borollic Vertic Cam-borthid	Fine textured alluvium	0-12 12-28 28-60	SIC SIC CL	CH CH CL	A-7 A-7 A-6	>60	0.06-0.2	Low	High High Moderate
Clowers	320	Fine loamy, mixed (cal-careous), frigid, Typic Torrifluvent	Alluvium on floodplains	0-4 4-60	L SR-SL-CL	CL-ML,ML CL-ML, ML	A-4 A-4	>60	0.6-2.0	Moderate	Low
Cothran	248	Mixed, frigid Ustic Torripsamment	Wind deposited sands	0-60	FS, LFS	SM, SP-SM	A-2	>60	6.0-20.0	Low	Low

CHEROKEE APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL [2]	CLASSIFICATION [3] DEPTHS (INCHES)	USDA	UNIFIED	AASHO	DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
Rallod	245, 246	Clayey, montmorillonitics, shallow Borollic Natraraid	Residuum from alkaline shales	0-12	SC	CH	A-6, A-7	10-20	0.06-0.2	Low	High
Ravalli	210	Fine-loamy, mixed Borollic Natrargid	Alluvium from alkaline shales	0-2 2-14 14-20 20-60	SL L CL L, VFSL	SM ML CL ML	A-4, A-2 A-4 A-6 A-4	>60	0.06-0.2	Low	Moderate
Rock River	225, 231, 234, 250	Fine-loamy, mixed Borollic Haplargid	Alluvium from sandstone	0-3 3-19 19-60	SL SCL SL	SM SM, SM-SC SM	A-2 A-4 A-2	>60	0.6-2.0	Low	Low
Ryark	231,234	Coarse-loamy, mixed Borollic Haplargid	Sandy alluvium	0-18 18-60	SL GRF-S	SC, SM-SC SP-SM	A-2 A-1	>60	0.6-2.0	Low	Low
Seaverson	237, 245	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthent	Residuum from alkaline shales	0-18	CL	CL	A-6	10-20	0.2-0.6	Low	Moderate
Shinbara	202, 235	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthent	Residuum from siltstone and loamstone	0-8 0-8	L GR-L	CL-ML, ML CM-GC, GM	'-4 A 4	2-10	0.6-2.0	Low	Low
Tasselman	202	Loamy, mixed (calcareous), frigid, Lithie Torriorthent	Residuum from sandstone	0-3 0-3 3-14	SL GR-SL GR-SL	SM GM, SM GM, SM	A-2 A-1, A-2 A-1, A-2	10-20	2.0-0.6	Low	Low

CHEROKEE APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL [2]	CLASSIFICATION [3] DEPTHS (INCHES)	USDA	UNIFIED	AASHO	DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
Crestman	248	Mixed, frigid, shallow Ustic Torripsamment	Residuum from sandstone	0-16	LFS	SM	A-2	10-20	6.0-20.0	Low	Low
Cushool	225, 231, 234, 236, 246, 247	Fine-loamy, mixed Borollic Haplargid	Residuum from sandstone and siltstone	0-3 3-18 18-30	SL SCL SL	SM, SM-SC SM,SM-SC,SC SM, SM-SC	A-2 A-4, A-6 A-2	20-40	0.6-2.0	Low	Low
Delphill	207,232	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthent	Residuum from loam stones and sandy shales	0-3 3-28 28-42	L L,CL,SKL WB	CL-ML,CL,ML CL-ML,CL	A-4, A-5 A-4, A-6	20-40	0.6-2.0	Moderate	Low
Diamondville	232, 241, 247	Fine-loamy, mixed Borollic Haplargid	Residuum from interbedded loamstones and	0-7 7-20 20-28	L CL L	CL-ML CL CL-ML	A-4 A-6, A-7 A-4	20-40	0.6-2.0	Low	Low Moderate Low
Fleutch	37A	Fine-loamy, mixed Borollic Haplargid	Slope wash alluvium	0-2 2-26 26-60	LS FSL LFS	SM SM SM	A-2 A-4 A-2	>60	0.6-2.0	Low	Low
Forelle	210, 241	Fine-loamy, mixed Borollic Haplargid	Alluvium from sandstones and shales	0-4 4-20 20-60	L CL, L GR-SCL	CL-ML, ML CL GC, SC	A-4 A-6 A-2	>60	0.6-20	Moderate	Low Moderate Moderate
Lisam	238	Clayey, montmorillonitic (calcareous), frigid, shallow Ustic Torriorthent	Residuum from shales	0-2 2-16	SIC SIC	CH CH	A-7, A-6 A-7, A-6	10-20	0.06-0.2	Low	High
Monte	320	Fine-loamy mixed (calcareous), frigid Typic Torriorthent	Alluvium	0-7 0-7 7-60	L SL L	ML SM, SM-SC	A-4 A-2, A-4 A-4	>60	0.6-2.0	Low	Low

CHEROKEE APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL[2]	CLASSIFICATION[3]				DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
				DEPTHS (INCHES)	USDA	UNIFIED	AASHO				
Worfman	236, 347	Loamy, mixed, shallow Borollic Haplargid	Residuum from soft calcareous sandstone	0-10 10-17	SCL SCL	SC, SM-SC SC, SM-SC	A-2, A-6 A-2, A-6	10-20	0.6-2.0	Low	Low
#15	210	Fine-loamy mixed Borollic Camborthid	Alluvium	0-45 45-60	L SL	---	---	>60	---	---	---

1. Classification: Classification of each soil series according to Soil Taxonomy USDA 1975.

2. Parent Material: Geologic material that soil developed from.

3. Classification: Depths are of soil profiles, USDA classification is the soil textural classification system, the unified and AASHO classifications are used by engineers unfamiliar with the USDA textrual classification system.

4. Depth To Bedrock: Refers to the soil range in depth to bedrock.

5. Permeability: Refers to the rate at which water and air may move through the soil.

6. Potential Frost Action: Refers to the probable effects on structures resulting from the freezing and thawing of soils.

7. Shrink/Swell Potential: Refers to the quality of a soil that determines its volumemetic changes resulting from wetting and drying of soil profile.

HANNA SOUTH
proposed project

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

In October 1976, Arch Mineral Corporation submitted a preliminary mining and reclamation plan for the proposed Hanna South project to the Area Mining Supervisor, Geological Survey (GS), describing a proposed 10-year mine. An updated mining and reclamation plan was submitted to GS on January 6, 1978. The plan was accepted by GS for review. Construction and mining would begin in 1979; mining would require 100 permanent employees.

The mining and reclamation plan included in this statement was submitted for review during or prior to promulgation of the initial regulations (30 CFR 700) required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87) and has not been officially reviewed for compliance therewith. Therefore, the applicant's plan may not fully reflect the requirements of the initial regulations. However, in this statement the initial regulations are considered as required federal mitigating measures the same as all other applicable regulations.

The mining and reclamation plan will be returned to the operator for revision in accordance with the applicable initial regulations. As soon as the applicant's plan is revised and returned to GS it will be evaluated with the Office of Surface Mining to determine compliance with the requirements of Federal Regulations at 30 CFR 211 and 30 CFR 700. The mining and reclamation plan cannot be approved until it conforms to all applicable federal requirements.

The proposed Hanna South project area lies within the checkerboard land ownership pattern and contains 4,127 acres; 640 federally owned and 3,487 privately owned (both surface and coal) (see Figure HS1-1 and Map HS1-1). The private land is owned by Rocky Mountain Energy Company and leased to Arch Mineral. Federal coal lease W-25406 contains 640 acres and is located in Section 32, T. 22 N., R. 81 W., 6th P.M.

The mining and reclamation plan, and supporting data submitted by Arch Mineral are on file at the Office of the Area Mining Supervisor, GS, Conservation Division, Denver, Colorado; and at the District Office, Bureau of Land Management, Rawlins, Wyoming, and can be reviewed by the public at those locations.

PROPOSED ACTION

The action before the federal government is to consider for approval the mining and reclamation plan presented by the Arch Mineral Corporation.

Purpose and Objective

The purpose of the proposed action is to allow mining of 6.1 million tons of coal at an average rate of 610,000 tons per year (see Figure HS1-2). The coal would be sold at Hanna to Energy Development Company, a subsidiary of Iowa Public Service Company. It is assumed the coal would be shipped to Midwest utilities.

Location

The proposed mine would be located approximately 2 miles southeast of Hanna, Wyoming. The proposed mine is in the checkerboard area of public, state, and private land along the Union Pacific Railroad. If the federal coal was not developed, it would not be economical to develop the private coal. Surface and coal ownership are shown in Table HS1-1 and on Map HS1-2.

Predisturbance Inventories and Analyses

Specific inventories were conducted under the direction and/or cooperation of Arch Mineral in consultation with the BLM concerning threatened and endangered plants and animals, raptor nesting sites, archeological sites, historical sites, and paleontological localities.

An inventory was conducted by the BLM on the proposed Hanna South project area for proposed endangered and/or threatened plant species. The inventory did not reveal the presence of any plants listed on the current (1977) list of proposed endangered and/or threatened species.

The Wyoming State Game and Fish Commission conducted an inventory, funded by the BLM, of raptor nesting sites on and adjacent to the proposed project area. No nests (active or inactive were found in areas which would be physically disturbed by the mining operations. The Fish and Wildlife Service will survey the project area for prairie dog towns and possible black-footed ferret habitat. The survey will be funded by BLM.

The State Historic Preservation Officer was consulted concerning any National Register sites within the project area.

A cultural inventory was conducted on the project area during 1976 by the University of Wyoming.

An Order III soil survey was conducted on the project area by the Soil Conservation Service. In accordance

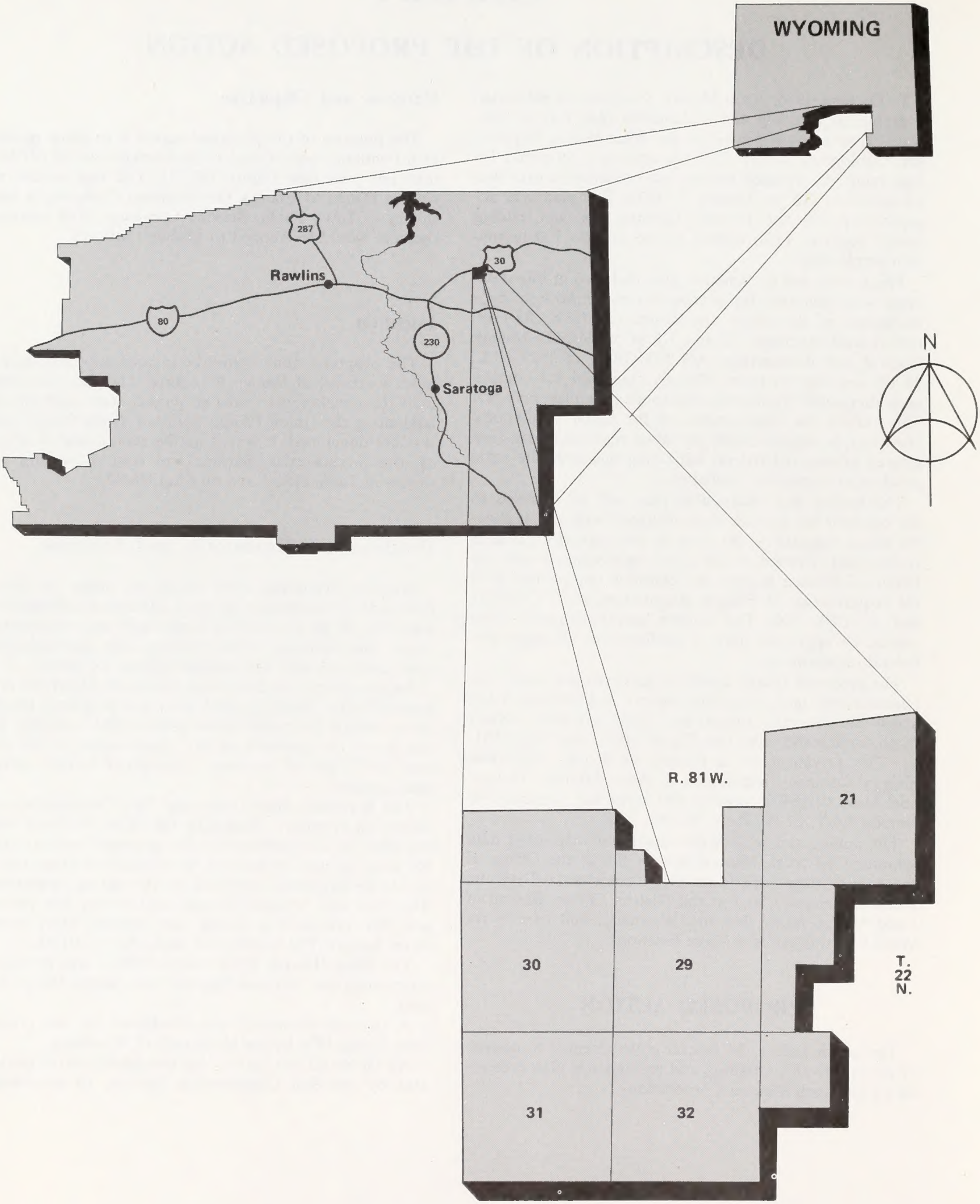
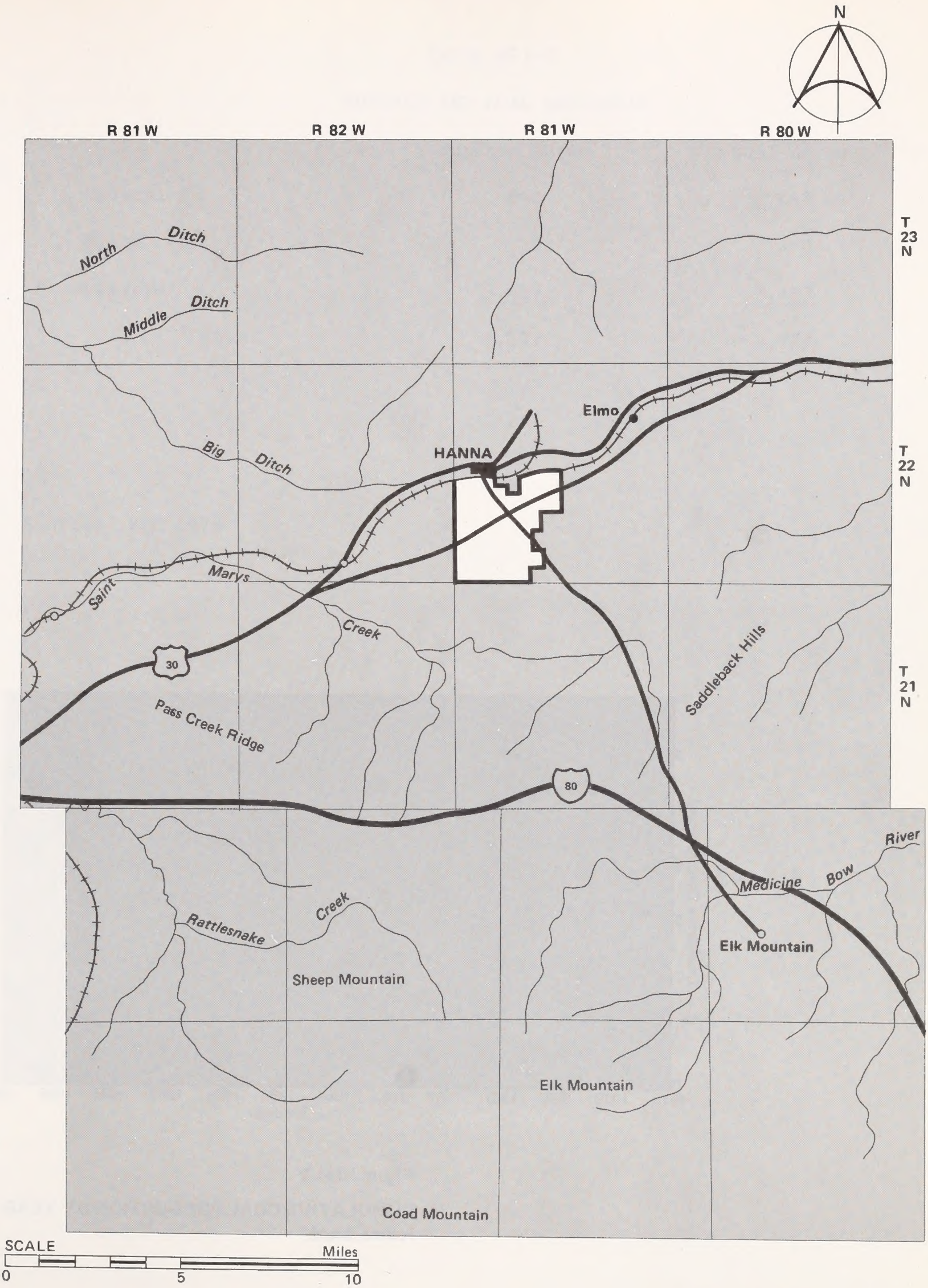


Figure HS 1-1

GENERAL LOCATION
Hanna South



Map HS 1-1

VICINITY MAP
Hanna South

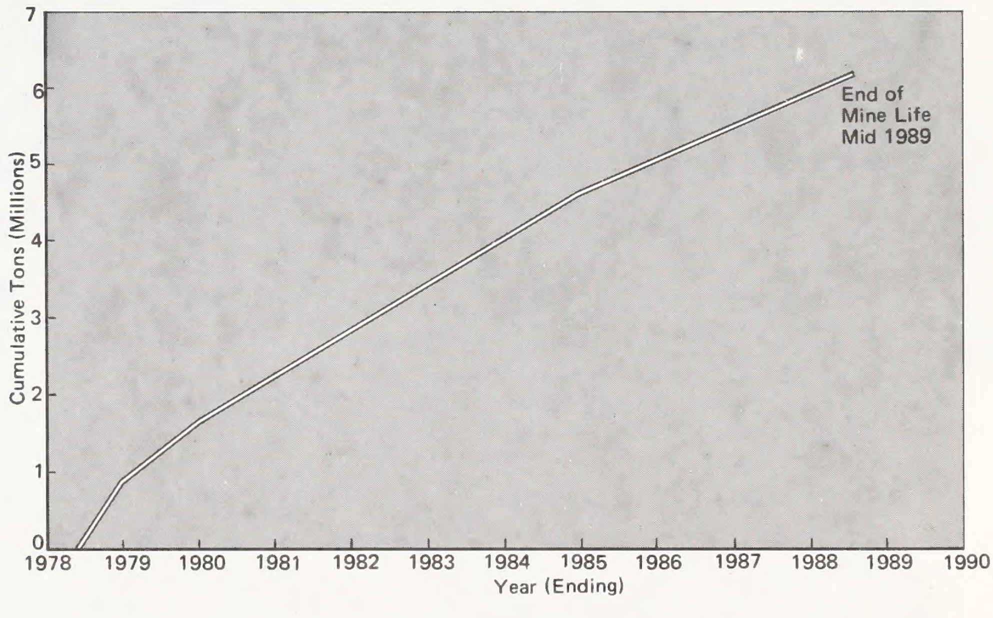


Figure HS 1-2

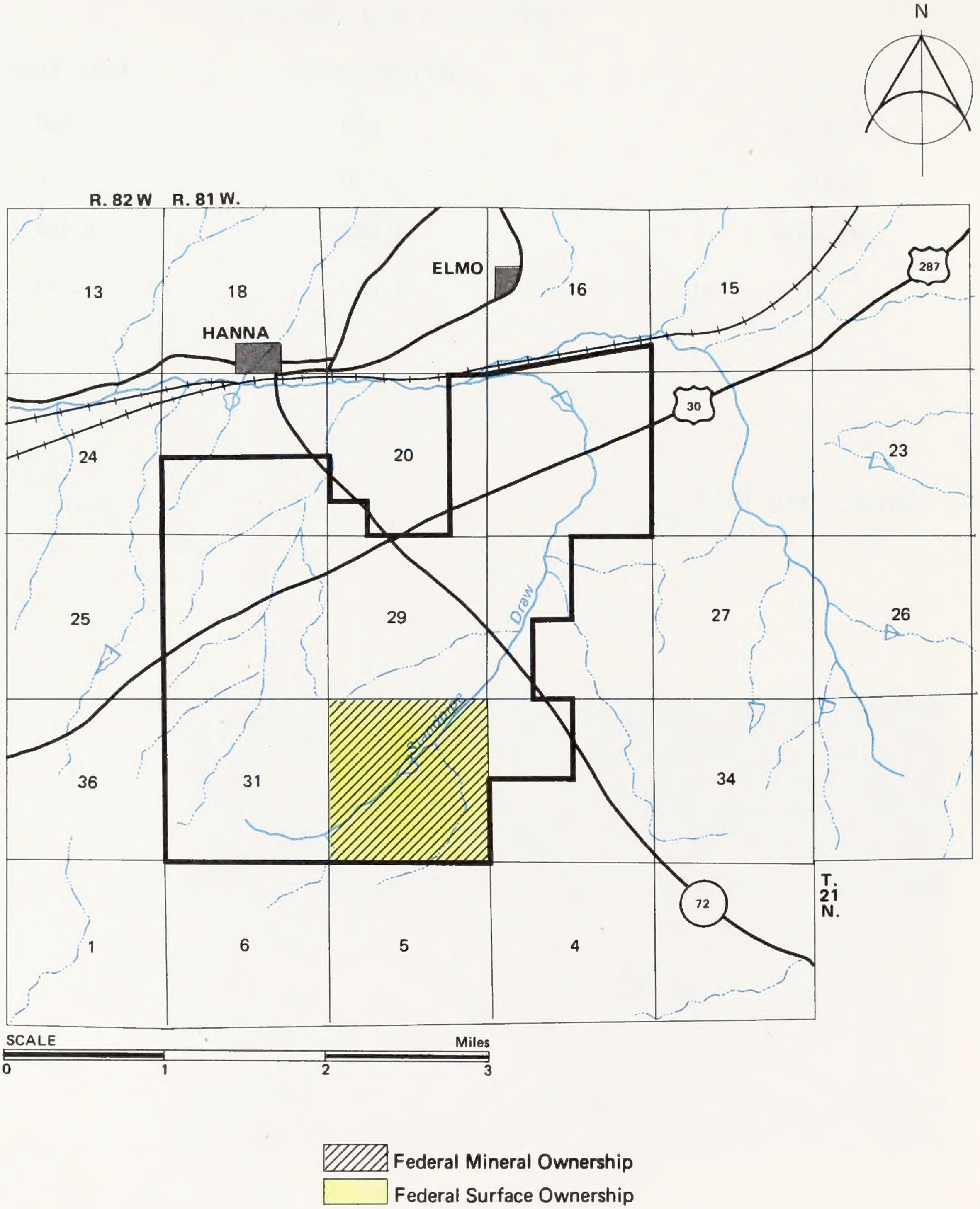
CUMULATIVE COAL PRODUCTION BY YEAR
Hanna South

Table HS1-1

SURFACE AND COAL OWNERSHIP

	Surface Acres	Coal Acres
Federal	640	640
State	0	0
Private	3,487	3,487
Total	4,127	4,127

Source: BLM 1978



Map HS 1-2

SURFACE AND MINERAL OWNERSHIP
Hanna South

with the mining and reclamation plan, analyses of the overburden will be made for physical and chemical properties.

Arch Mineral contracted a hydrologic study on the project area. Further studies are planned prior to mining.

Mine and Related Facilities

The Hanna South Mine is proposed as a truck-shovel stripping operation. Mining and related activities would ultimately disturb 834 acres; 126 publicly owned and 708 privately owned.

Mine construction activities would begin with the construction of the mine access road and site preparation for the office and shop approximately 6 months before coal production. The mine construction work force would peak at about 20. During this time, work on drainage diversions, topsoil recovery, sedimentation ponds, and haul roads would also begin.

The surface facilities (shop, office, changehouse, warehouse) would disturb about 25 acres of private land by 1985 (see Map HS1-3).

The mine office and shop complex would be constructed in the central portion of the mine area south of the intersection of U.S. 30 and State Highway 72. The major structures would be an office, shop and warehouse building, and changehouse. A fuel oil storage tank, a gasoline storage tank, and facilities associated with fuel loading and dispensing would also be constructed at the site. Dikes to contain more than (110%) the total volume of the tanks would be constructed around the storage tanks. Parking, outside storage areas, and miscellaneous storage structures complete the office-shop complex. Explosive storage would be separate from the office-shop complex and built to applicable standards.

Mining Equipment

Removal of the overburden from the coal would be accomplished by the use of a hydraulic excavating shovel and 85-ton rear-dump trucks, front-end loaders, and miscellaneous service vehicles. The overburden drill would be diesel powered. Bulldozers would be Kmoatsu 355 type or similar. Motorgraders would be Caterpillar 14 to 16 models. Coal haulage trucks would be highway trucks of 23-ton capacity. Front-end loaders would be Caterpillar 988 or 992 or similar size. Many of the larger items of mining equipment would require on-site assembly prior to commencing operation. The erection site for major mining equipment would be in the vicinity of the Energy Development Company rail spur. Other pieces of equipment would be assembled in the shop area.

It is expected that the mining equipment would consume about 1 million gallons of diesel fuel and 100,000 gallons of gasoline in addition to an unspecified amount of electric power during the life of the mine.

Coal Handling Equipment

The coal would be hauled in 23-ton highway trucks to Energy Development Company's tipple west of Hanna.

Support Developments

Roads

Highway access to the Hanna South area is via U.S. Highway 30 and State Highway 72. The mine property would be connected to Highways 30 and 72 with a 900 foot access road, designed and built by the mine operator to county specifications. The haul roads and access road would total 12.9 miles (access road—.2 miles; haul roads—12.7 miles). All roads would be constructed in conformance with Federal Regulations 30 CFR 715.17(1).

Haul roads would be about 100 feet wide and would be constructed from materials found at the mine. They would be designed as needed to support the vehicles using them. The wearing surface would be gravel or clinker, and dust would be controlled by water trucks. These roads would be reclaimed when mining in the areas they serve is completed.

Natural drainage along the access roads would be maintained by use of metal culverts where needed, and appropriate erosion control structures would be constructed as needed. All mine roads other than the main access road would be considered private. Internal mine roads would be used only by employees or other authorized persons; the public would be excluded for reasons of safety.

Power Line

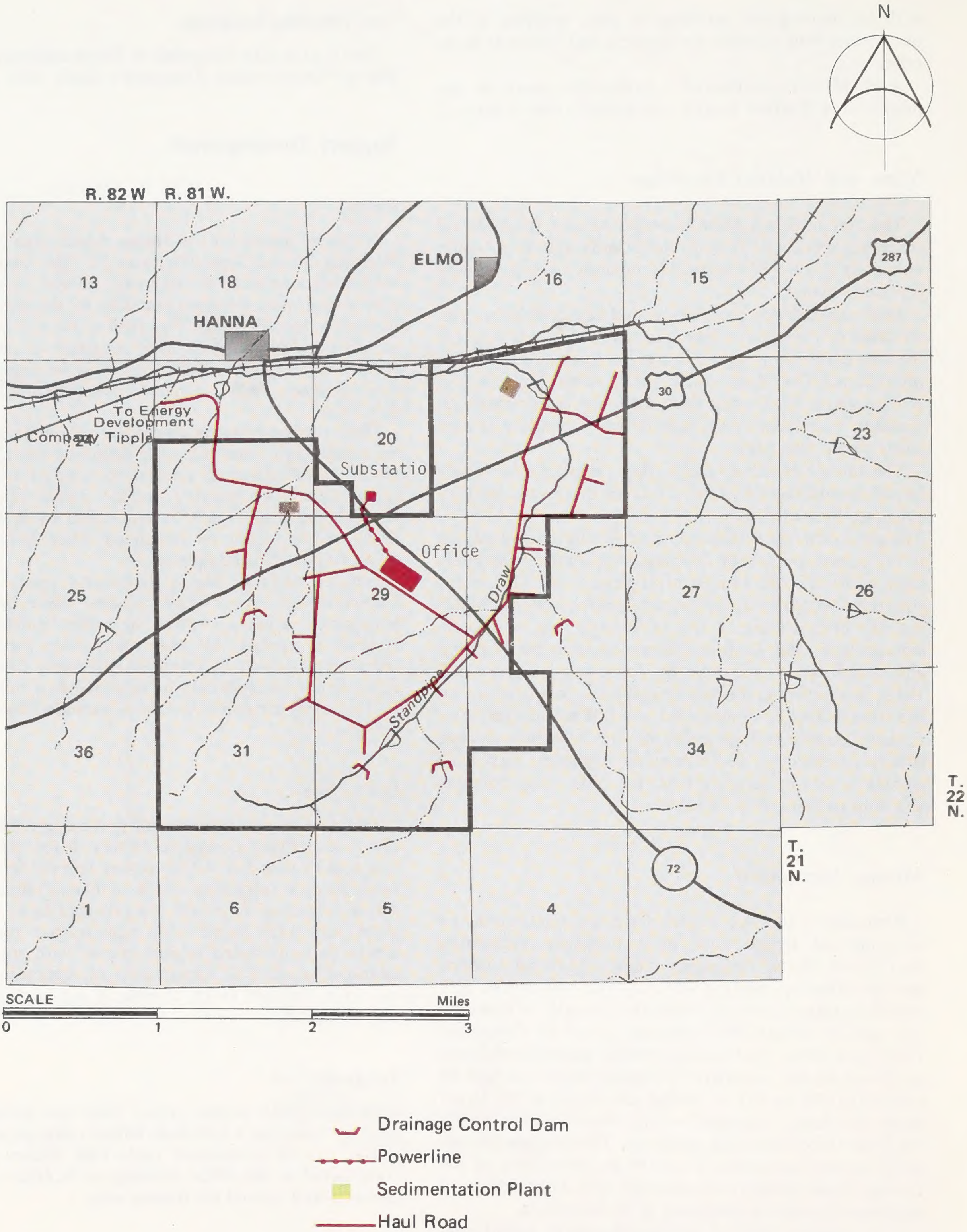
Electric power would be purchased from Pacific Power and Light Company. Plans call for the construction of 0.46 miles of 34.5-kv power line (50 foot right-of-way) from a substation north of Hanna Junction. The major consumers of power are expected to be the office, shop, and yard lights. All mine-related power lines would be constructed in accordance with standards established in the U.S. Department of Agriculture's bulletin, REA Bulletin 61-10, to reduce accidental electrocution of raptors.

Telephone Line

Mountain Bell would extend telephone service to the mine by installing a 0.46 mile buried cable parallel to the power line. A short-wave radio base station would be constructed at the office building to facilitate communication in and around the mining area.

Water Supply and Sewage Treatment

On-site wells, are proposed as the source of potable water. Based on a daily per capita consumption of 35



Map HS 1-3

MINING AND ANCILLARY FACILITIES
Hanna South

gallons, a maximum of 4,500 gallons per day (3,600 gpd average) of potable water would be required. Mine drainage would supply most of the estimated 113,000 gpd of plant water required during the summer months (15,000 to wash and steam clean equipment; 96,000 to spray haul roads; and 2,000 for housekeeping). Mine drainage would be supplemented by water from wells on the property. A 100,000 gallon supply of water would be maintained for fire protection.

Sewer lines from the project office and shop-warehouse building would be connected to a septic system designed to state requirements. The system would be sized for 7,000 gpd and designed to accommodate peak flow periods. In the mining and coal handling areas, approved portable facilities would be provided. Table HS1-2 presents a summary of proposed support facilities for the Hanna South project.

Proposed Mine Layout and Mining Sequence

The Hanna South Mine would be oriented along a generally northeast to southwest axis on the southern end of the Hanna syncline, and would be mined in three blocks. Block 1 is on the toe of the syncline (see Figure HS1-3), block 2 is on the east flank, and block 3 is on the west flank. On the basis of the mining sequence, the acres disturbed by time period are shown in Table HS1-3. The mining sequence presently planned is as follows: first block—years 1 to 3; second block—years 4 through 6; and third block—years 7 to 10 (see Map HS1-4). The topsoil material would be compacted by the scrapers during the stockpiling process. This would help reduce erosion. To further minimize the possibility of wind and water erosion and to enhance the viability of soil organisms, the piles would be seeded with a quick growing vegetative cover.

Mining and Reclamation Operations

Topsoil Removal and Deposition

All recoverable topsoil material (material capable of sustaining plant growth) covering the mining pit area, overburden storage areas, and haul roads would be removed to average depths by scrapers. To minimize erosion, the area stripped of soil material would be limited at all times to that which would be disturbed by mining activities within the following several months. The topsoil material would be stored in stockpiles (see Map HS1-5) for eventual redistribution, or directly deposited upon reclaimed overburden and mining areas (backfilled, graded, and contoured). The stockpiles of soil material would be located in areas which would not be affected by the mining operations, yet close enough to facilitate easy replacement. Topsoil handling will be done in conformance with Federal Regulation 30 CFR 715.16.

Watercourses, Drainage Channels, and Impoundments

Mining operations in the Hanna South area would cross several established drainage channels. In order to control the flow of water into the mine pits and to control water pollution, four major drainage channels would be dammed upstream of the mining area. The dams would be designed to retain the runoff resulting from the 100 year/6 hour storm. Any flows greater than this would be passed through a spillway and flow into the pit. Surface water diversions will meet standards set in Federal Regulations 30 CFR 715.17(a).

All groundwater discharged into the mine pits would be treated in two settling ponds before it leaves the permit area. Because of the relatively flat terrain, the settling ponds may be of the dugout type.

All permanent roads would be ditched where possible to control any runoff. Water bars would be employed where necessary. In addition, berms would be placed along all spoil banks to intercept runoff which may have a high concentration of suspended solids.

When no longer needed, the settling ponds, berms, ditches, and water impoundments would be removed (unless the landowner wished them to remain) and their locations reclaimed.

Overburden Removal and Disposal

After all recoverable topsoil material has been removed, remaining unconsolidated overburden material would be removed by scrapers. After the consolidated overburden material has been reached, it would be drilled and blasted. All blasting would be done in accordance with Federal Regulations 30 CFR 715.19.

After the overburden has been blasted, it would be dug by a diesel powered hydraulic shovel and loaded into 85-ton rear-dump trucks for removal. The truck-shovel system would remove the overburden from a 200 foot wide area consisting of 25 to 30 foot benches along the length of a pit until the coal is exposed. Overburden would be hauled from the pit by use of haulage ramps in the highwall side of pit and dumped into a previously mined out pit or hauled to the nearest temporary overburden stockpile for future backfilling. This system would be repeated down dip of the coal seam until overburden thickness has reached an economic limit. Overburden disposal sites would be designed to meet standards set in 30 CFR 715.15.

Temporary stockpiles for overburden would be constructed at five locations (see Map HS1-5). These stockpiles would be used to store overburden material from initial pit openings in their respective areas. Once each area has been mined the last pits opened would require backfilling. Since all possible haulback material would be used in backfilling initial pit cuts, it is proposed to use this temporarily stockpiled material for final backfilling.

Coal Removal

After the coal has been drilled and blasted, a front-end loader would load it into highway type 23-ton trucks for

Table HS 1-2

PROPOSED SUPPORT FACILITIES FOR THE HANNA SOUTH MINE

Applicant	Proposed Facility	Application Number	Total Length (miles)	Width (feet)	Acres Required		Location of Public Land Affected
					Public	Private	
N/A*	Haul Road	N/A	.27	100	0	3.4	N/A
N/A	Power Line	N/A	.16	50	0	.94	N/A
N/A	Telephone Line	N/A	.16	16	0	.3	N/A
	Drainage Control Dam	None Yet	N/A	N/A	11	0	Section 28, T.22N., R.81W.

Source: BLM 1978

*Not applicable--no federal right-of-way required

Table HS1-3

DISTURBED ACRES DUE TO MINING SEQUENCE*

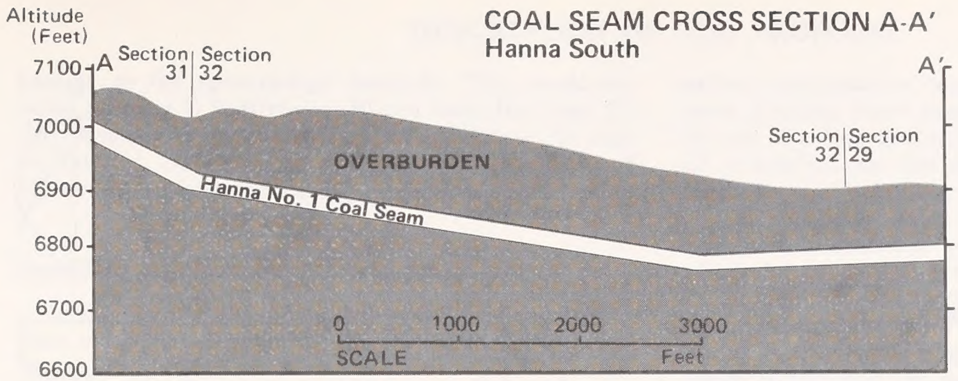
Year Period	Public Acres Disturbed	Private Acres Disturbed
Present to 1980	56	119
1981 to 1985	34	393
1980 to 1990	0	130
Total	90	642

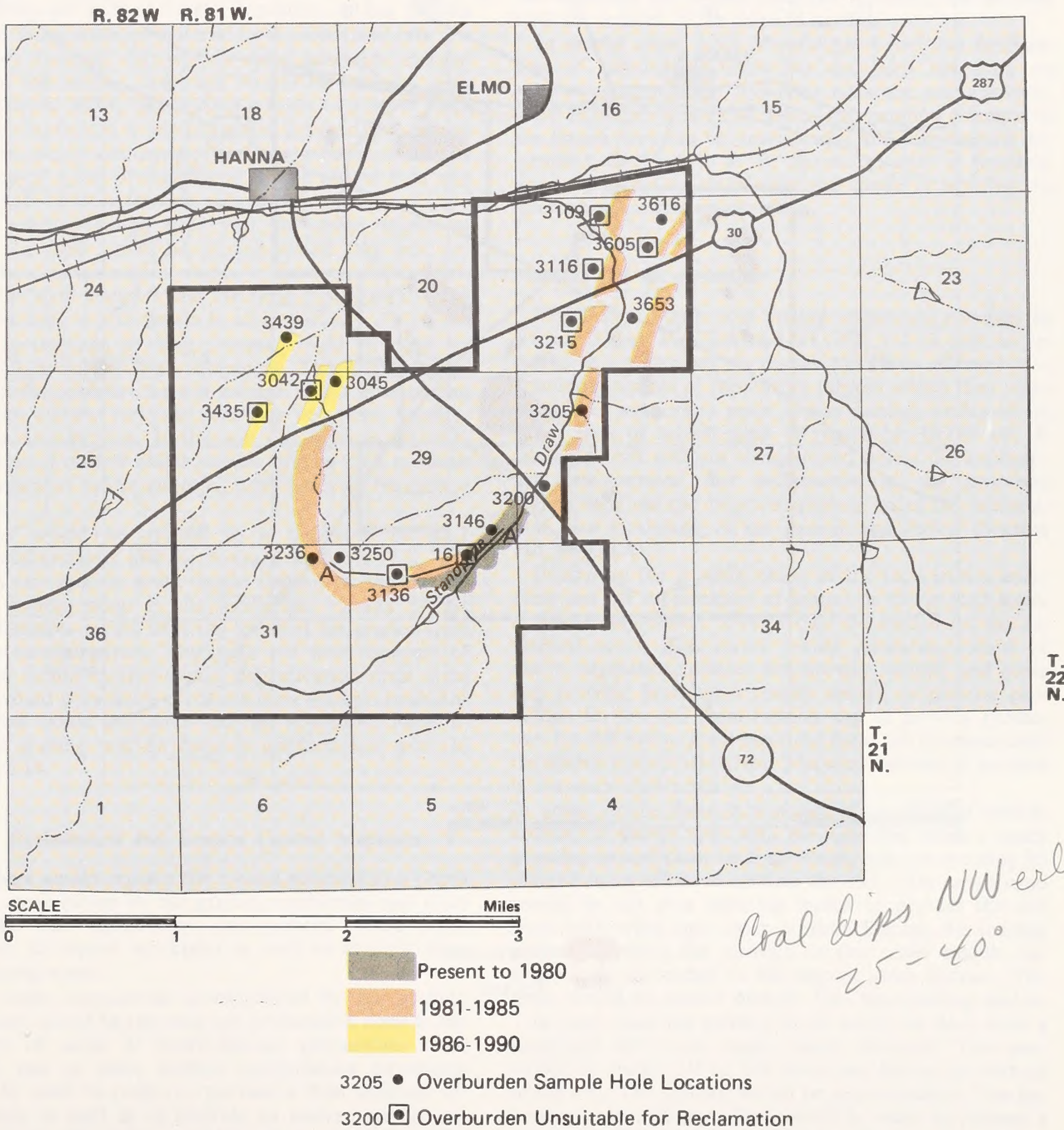
* Final Contour Acreage--total area disturbed within the project area by mining and reclamation operations (Noncumulative)

Source: BLM 1978

Figure HS 1-3

COAL SEAM CROSS SECTION A-A'
Hanna South

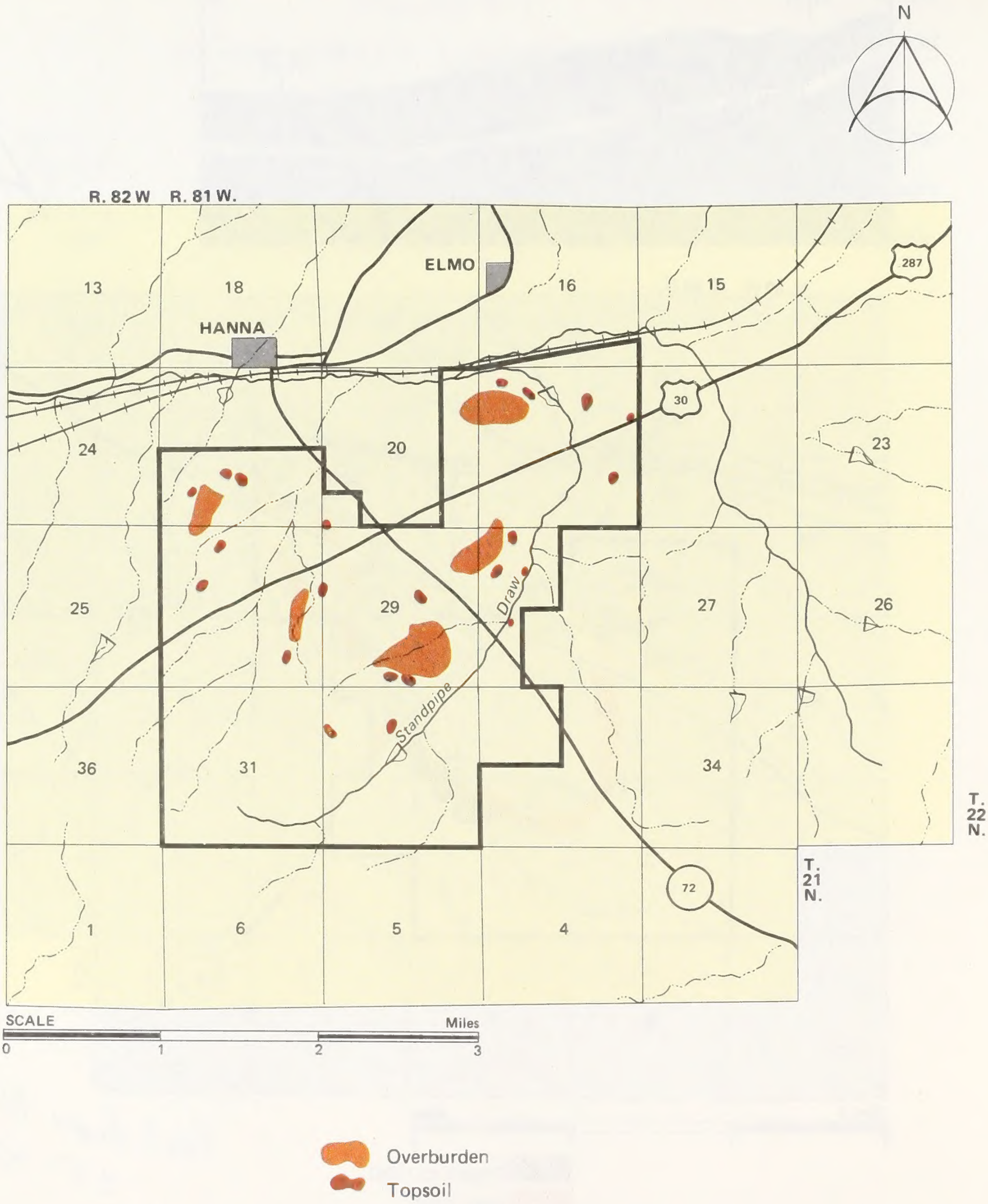




Coal dips NWerly 25-40°

Map HS 1-4

MINING SEQUENCE MAP
Hanna South



Map HS 1-5

OVERBURDEN AND TOPSOIL STORAGE

Hanna South

haulage to the open-storage stockpile. This would involve crossing U.S. Highway 30 and State Highway 72. The company proposes that these trucks deliver the coal to Energy Development Company's tipple west of Hanna for crushing and loading into railroad cars.

Backfilling and Grading of Overburden

Backfilling the pits and grading the spoil would be done as integral parts of the mining operation. Reclamation grading would commence as soon as possible on all the affected areas, as the coal is removed and the pits were no longer needed for the deposition of any parting material or overburden material from subsequent pits.

Parting material and similar waste products encountered in the mining operation would be covered with spoil material during the grading process to a depth sufficient to ensure that it would remain covered and also to ensure it would not hamper the revegetation effort. A minimum of 4 feet of material would be placed over any acid, alkali, or toxic forming substances.

The grading design used and the slope degree at which the spoil would be graded would take into account the average natural slopes in the area, the erodibility of the spoil material, and the slope exposure. Erosion would be kept to a minimum in all instances.

The reclamation grading process would be done by track and/or rubber tired equipment. This heavy equipment should compact the soil enough to aid in stablizing the slopes without seriously retarding vegetative reestablishment and growth. If the soil did become severely compacted, a disk or chisel plow would be used to break up compaction before attempts were made to revegetate the area.

Slopes would be graded to a minimum of 3.6:1 (horizontal:vertical) and an average slope of 7:1. The slope at any specific point would depend on the overall natural configuration in the immediate vicinity of the spoil. Attempts would be made to blend the graded spoil into the natural terrain. The south and west exposure of the spoil would receive special consideration since these slopes would pose more problems in vegetative establishment than would the north and east exposures. Backfilling and grading will be done in conformance with 30 CFR 715.14.

Topsoil Replacement and Erosion Control Measures

Scrapers would replace the topsoil material to a depth of 6 or more inches on the graded overburden and mine pit areas. This replacement soil material would come from the 22 topsoil stockpiles as well as directly from new mining areas.

The slight compaction accomplished by the grading equipment would be the only soil preparation done in the majority of areas. If more intense preparation were needed, one or more surface manipulation treatments would be used in order to provide a firm seedbed for vegetation as well as to provide an uneven surface topography to reduce the possibility of erosive action. The surface manipulations being considered are modified terraces, gouging, dozer basins, chisel plowing, disking, and the use of a road grader on the contour of the slope. In all probability, the last method (use of a road grader) would be used before the others were attempted because of the speed with which it could be accomplished. The road grader treatment would only be done on spoils which did not have a preponderance of rock at or near the surface. The road grader would make two or three passes along the slope. The dirt, thus moved, would be left as a windrow along the contour. Then the road grader would start the process over immediately below the windrow and would continue repeating the process until the bottom of the slope is reached.

In nearby areas, Arch Mineral has found that fertilization of reclamation areas has not been necessary to achieve plant growth. Available moisture, not nutrients, is the principal limiting factor. If revegetation attempts in the future prove to be unsuccessful and soil analysis determines fertilization to be necessary, then a fertilizer program would be established and tested in an effort to establish successful revegetation.

Planting and Revegetation

The Hanna South coal mining operation, pursuant to Section 515 of SMCRA and 30 CFR 715.13, will be required as a minimum, to restore the lands affected to a condition capable of supporting the use which they were capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. A mining permit will not be approved unless the applicant has demonstrated that reclamation to the proposed mining land use can be accomplished under the reclamation plan contained in the permit application (Section 510, SMCRA).

Following the grading phase of the reclamation operation and the replacement of topsoil on the graded areas, a diverse vegetation cover would be seeded on the reclaimed areas. This cover would primarily consist of native vegetation, grasses and browse species, and some fast growing introduced species seeded to provide protection for the soil from erosion and to provide protection for the native grass seedlings from the elements until the native species take over. The seed mixture to be used is shown on Table HS1-4.

In areas where there is a potential problem of serious erosion, as would exist with the topsoiled areas, a quick growing annual plant such as wheat, oats, or rye may be planted in an effort to stablize the soil. This cover crop would be left as a standing mulch to protect the soil from both wind and water erosion. During the seeding period following the planting of this cover mulch, the area would be seeded to the regular grass mixture. The grass would be seeded directly into the standing mulch.

In most cases the seeding work would be done with a rangeland drill with depth bands attached. The seed would be placed 1/4 to 3/4 of an inch below the surface of the soil. The spacing would be approximately 7 inches between rows. Every effort would be made to prepare a relatively firm seedbed which is free from noxious

Table HS 1-4

RECLAMATION SEEDING MIXTURE

Russian Wildrye	1.50 pound/acre
Thickspike Wheatgrass	3.50 pound/acre
Western Wheatgrass	3.50 pound/acre
Slender Wheatgrass	2.75 pound/acre
Indian Ricegrass	.75 pound/acre
Yellow Blossom Sweetclover	1.50 pound/acre
Fourwing Saltbush	1.50 pound/acre
Total	15.00 pound/acre

Source: Hanna South Reclamation Plan

weeds. A modified grain drill would be used for seeding in flat areas. Broadcast seeding would be done only when the rangeland drill or the modified grain drill could not be used. Topsoil handling and seedbed preparation will be done in conformance with 30 CFR 715.16 and 715.20.

The majority of seeding would be done in the fall of the year, usually to commence in mid-September. Some seeding would also be accomplished during the spring, especially in early April. Seeding at this time would probably consist of the planting of the cover mulch in preparation for the seeding of the areas to the grass mixture during the fall.

Decommissioning and Abandonment

On completion of mining, final abandonment of the property would include the removal of all facilities except those necessary or desirable for subsequent uses, subject to the approval of the area mining supervisor and affected surface owners. The disturbed sites would be graded, covered with topsoil, and seeded (see Table HS1-5).

Present and Future Land Use

The current and past uses of the proposed project have been primarily transportation and utility corridors, livestock grazing, and wildlife habitat. Carrying capacity for grazing is closely tied to vegetative productivity, particularly to those species with high forage value. Wildlife use is dependent on both food availability and cover. Cover includes both vegetation and landforms; important vegetative cover includes shrubs and grasses. Based upon these aspects, the proposed use of the reclaimed lands (as recommended in the Hanna Land Use Plan—MFP) would include both grazing for domestic livestock and wildlife habitat. The standard for determining if adequate grazing has been restored for the support of domestic livestock would be based upon vegetative cover and forage productivity. The company proposes to give special consideration for wildlife habitat on approximately 25% of disturbed acreages during reclamation.

Management of Reclaimed Areas

Once the area is reclaimed with a satisfactory vegetative cover being well established and ready for grazing, management would be returned to the surface owner or user.

Pollution Control Methods

Dust from mining operations and haul roads would be contained by watering techniques.

If material creating a fire hazard (coal waste) were uncovered during, or as a result of, the mining process, it would be removed, covered, or buried. Culverts or bridges would be installed where necessary to allow access by the surface owner and the mine operator for fire control purposes. When a pit is completed or abandoned, the face of the coal would be covered with a noncombustible material.

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposed action. A more complete description of the authorizations is provided in Chapter 1 of the Regional Analysis.

Assistant Secretary of Energy and Minerals

The Assistant Secretary shall approve the mining permit application and significant modifications or amendments thereto prior to commencement of mining operations by the company. The mining permit application includes the proposed mining and reclamation plan.

Office of Surface Mining (OSM)

OSM, with concurrence of the surface managing agency (BLM) and GS, recommends approval or disapproval of a mining and reclamation plan to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a state-federal cooperative agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and department authorized to take final actions on the permit.

Bureau of Land Management (BLM)

The BLM developes the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources other than coal and the post-mining land use of the affected lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

Geological Survey (GS)

GS is responsible for development, production, and coal resource recovery requirements included in the mining permit.

Table HS1-5

TOTAL CUMULATIVE DISTURBED AND RECLAIMED ACRES*
HANNA SOUTH

	Public Acres		Private Acres	
Year	Disturbed	Reclaimed	Disturbed	Reclaimed
Present to 1980	92	0	151	0
1981 to 1985	126	126	553	54
1986 to 1990	126	126	683	638

* Reclaimed acres--involves time for backfilling, grading, contouring, topsoil replacement, and initial seeding.

Source: BLM 1978

State and County

Wyoming Department of Environmental Quality (DEQ)

Whenever Wyoming enters into a cooperative agreement with the Secretary of the Interior pursuant to section 523(c) of SMCRA, DEQ and OSM will jointly review and act on mining and reclamation plans and permits to mines authorized under a federal coal lease.

The Land Quality Division would issue a permit and license to mine upon its approval of a mining and reclamation plan. The Air Quality Division would issue permits to construct and permits to operate crushers or other point sources after a review of applications with regard to air contaminants and plans for control and monitoring. The Water Quality Division would issue permits to construct waste water systems. They also would issue National Pollutant Discharge Elimination System (NPDES) permits for discharging waste water. The Solid Waste Division would issue construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation.

Wyoming State Engineer

Any storage, impoundment, or use of surface or groundwater for mining and coal processing operations would require a permit from the State Engineer.

Wyoming Highway Department

The Highway Department would require an access and use permit for mining activity access and use on U.S. Highway 30 (two locations) and State Highway 72 (one location).

Carbon County

Carbon County would require a special use permit for mining activities within the scenic corridor along U.S. Highway 30 and State Highway 72.

INTERRELATIONSHIPS

Relationship to Land Use Plans

Bureau of Land Management

The Hanna Area Management Framework Plan (MFP) recommends coal mining on the Hanna South project area. Post-mining land use, should the mining be authorized, would be as designated in the MFP for utility corridor, livestock, and wildlife use.

Other recommendations (Hanna and Overland MFPs) related to coal development are for the BLM to provide additional land for community development in Rawlins, Saratoga, and Wamsutter. The BLM would provide land for sanitary landfills near Saratoga and in a central location for Hanna, Elk Mountain, and Elmo. There are plans for the BLM to allocate land for schools, parks, etc., for development of a water treatment plant in Rawlins, and for airport expansion in Rawlins. Preliminary sites have been recommended for these land transfers; however, final designations have not been made. The post mining land uses on the project area will be wildlife habitat and livestock grazing as recommended in the Hanna MFP.

Local

The area south of Hanna between the present corporate city limits and U.S. Highway 30 may be needed for future development, given the projected growth of the community. The general plan for Hanna proposes that this area be developed as an extension of existing land uses (schools, single and multiple family residences, business district, park, and mobile home courts).

At present, this area is outside Hanna's corporate limits and jurisdiction, and is zoned by Carbon County for ranching, agriculture, and mining.

Relationship to Regional Development

Other Coal

The Hanna South Mine would produce 6% of the 27.8 million tons of coal produced in the Hanna area by 1980, 4% of the 111.3 million tons produced by 1985, and 3% of the 201.4 million tons produced by 1990. This production would be 6% of the regional production projections of the 27.8 million tons by 1980, 4% of the 121.3 million tons by 1985, and 3% of the 241.4 million tons by 1990.

Other Regional Development

The proposed Hanna South Mine would be developed during the same time frame as other coal mine development in the Hanna Basin, uranium development in the Red Desert and Baggs areas, the ongoing regional exploration and development of oil and gas, and the regional increase in general construction to meet population needs.

Relationship to Regional Impacts

Development of the Hanna South Mine would add to the cumulative regional demand for labor, and would compete with other development occurring in the same time frame.

Relationship to Rail Transportation System

The coal would be transported in unit trains via the Energy Development Company railroad spur to the Union Pacific main line, where it would continue to Midwest markets or eastern Colorado. Once full production was reached, the project would add two to three unit trains, loaded and return traffic, per week to the projected regional increase in rail traffic.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

The climate of southcentral Wyoming is characterized by dry air masses, which are modified Pacific air masses moving eastward over the Rocky Mountains. The largest moisture source is easterly winds which provide most of the precipitation. Annual precipitation is low at 10 inches per year, most of which is the result of spring or early summer thunderstorm activity. Conversely, the mean annual lake evaporation is estimated to be about 36 to 42 inches annually. The prevailing winds are south to southwest; northerly and westerly winds are also common.

The proposed Hanna South Mine site is located about 34 miles east northeast of Rawlins in Carbon County in an area of gently rolling hills. Temperatures at the site average about 48°F annually. Winds are generally out of the southwest for much of the year with an average speed of 11 miles per hour (Figure HS2-1). Stable atmosphere conditions prevail about 80% of the time because of the cold temperatures and moderately strong winds. Surface-based inversions are very frequent despite the high average wind speeds. They occur in the mornings between 75% and 85% of the time annually; most frequently in summer, least frequently in spring. During afternoons, they are uncommon except in winters when they are observed about one-third of the time. For a discussion of severe weather events that could affect reclamation, see the Regional Analysis.

AIR QUALITY

Particulate air quality in undeveloped areas of southcentral Wyoming ranges from 19 micrograms per cubic meter ($\mu g/m^3$) to 31 $\mu g/m^3$ annual geometric mean as recorded at five state and privately operated particulate sampling sites. The mean concentration at the five samplers is 25 $\mu g/m^3$ and the median is 24 $\mu g/m^3$.

Two samplers were operated by Rocky Mountain Energy in Carbon County from January through December of 1977. These samplers were located at the Adams Ranch and at the Curry Ranch. The sampler at the Adams Ranch recorded an annual geometric mean of 31 $\mu g/m^3$ and maximum values of 136 $\mu g/m^3$ and 106 $\mu g/m^3$. The sampler at the Curry Ranch produced an annual geometric mean of 30 $\mu g/m^3$ and maximum values of 86 $\mu g/m^3$ and 71 $\mu g/m^3$. These data being the most recent, the existing particulate air quality at the Hanna South site is considered to be 31 $\mu g/m^3$.

There has been no intensive monitoring of gaseous pollutants in the area. Sampling for sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) was conducted at the Patrick Draw site for three months in 1976. Though these data are not of sufficient duration to specifically quantify the presence of these pollutants in the area it may be interpreted as an indicator of these pollutant levels at the site. The arithmetic mean concentration recorded for SO_2 and NO_2 was 26 $\mu g/m^3$ and 19 $\mu g/m^3$ respectively (Wyoming Department of Environmental Quality 1977), both of which are well below the Wyoming State standard. Concentrations at the remote mine site are most likely somewhat lower than these concentrations since fewer sources of these pollutants now exist at the proposed site.

Visibility at the site ranges from less than 1 mile to greater than 60 miles throughout the year. The primary causes of low visibility are fog, haze, dust, and blowing snow. Average visibility ranges from about 26 to 47 miles with greatest visibility occurring during spring and summer months.

GEOLOGY

Stratigraphy and Structure

The proposed project area lies southeast of Hanna (Map 1 in Appendix A) in the southern part of a structural province known as the Hanna Basin (Map 4 in Appendix A—also see Regional, Geology for a description of the whole basin).

The rocks exposed at the surface are part of the Hanna Formation, of Lower Eocene and possibly Paleocene age (50 to 60 million year old). The formation consists of conglomerates, sandstones, claystones, shales, and many coal seams (see section on Mineral Resources). The Hanna Formation, at least 10,000 feet thick, is underlain at an unknown depth in the Hanna South area by the Ferris Formation which crops out on the flanks of the basin.

In the project area, the Hanna Formation and its included coal seams dip northwesterly at 25 to 40 degrees toward the axis of the Hanna syncline. Four major coal zones, ranging from about 5 to about 20 feet thick occur within the 150 foot maximum depth to be mined. The coal seams are offset by a northwest trending series of strike-slip faults (Dobbin et al. 1929) so that the coal occurs in separate areas within the project boundary.

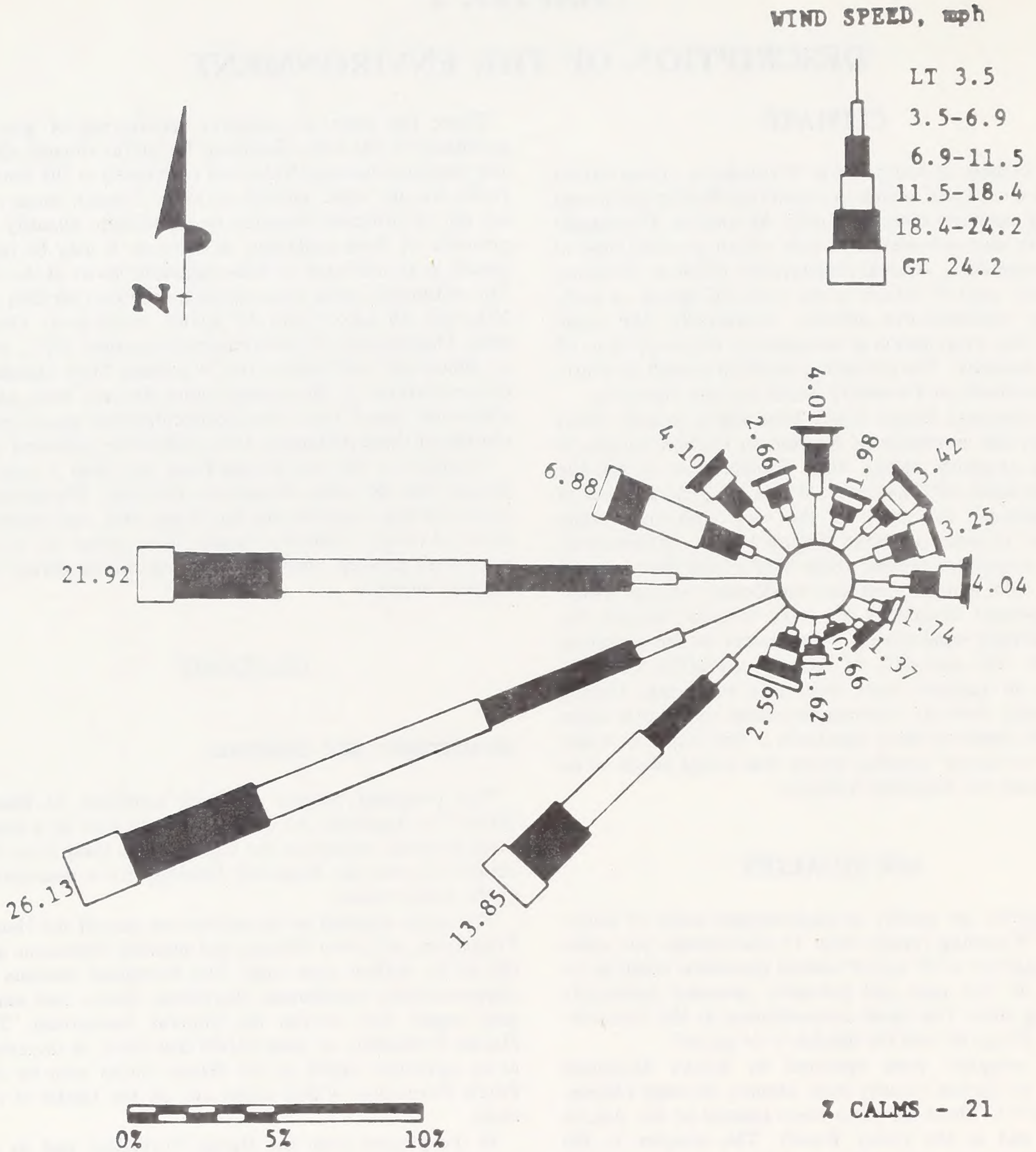


FIGURE HS2-1

ANNUAL WIND ROSE FOR THE PROPOSED
HANNA SOUTH MINE SITE

Source: National Climatic Center, STAR Program for Selected U.S. Cities, 1968.(Rawlins, Wyoming).

Geologic Hazards

The area is one of low seismicity as discussed in Geology, Chapter 2, Regional Analysis, and there is no undue tendency for land slides in the Hanna Formation.

Paleontology

The project area has not been surveyed for paleontological resources. The Hanna is the only fossiliferous formation in the project area. It is known to contain invertebrate, vertebrate and paleobotanical fossil materials of Upper Paleocene/Lower Eocene age.

TOPOGRAPHY

The average elevation of the proposed Hanna South project is about 7,000 feet above sea level. The topography is characterized by gently sloping terrain incised by ephemeral draws that drain northeasterly. The local relief is about 100 feet.

SOILS

Soil data for the Hanna South project area were taken from an unpublished Order III soil survey report done by the Soil Conservation Service (SCS) in the summer of 1977 (SCS 1978). This survey was correlated and expanded with survey data from a report submitted by Arch Mineral that was conducted by Mine Reclamation Consultants Inc. (MRC) of Laramie, Wyoming, in the fall of 1976 (MRC 1976e, 1976c). The soil survey on the Hanna South project area conforms to the latest accepted practices of the National Cooperative Soil Survey Program using the New Soil Taxonomy, USDA 1975. Mapping units are based upon soil types with similar properties. Separation is at family, association, complex, or series level. Additional units were not shown in each mapping unit if they were too small or complex to delineate or if the soil survey was not detailed enough to describe them.

Some of the principal soils found on the Hanna South project area that would be disturbed by construction and surface mining are in mapping units 253, 254, and 210 (see Soils Map HS2-1). Soils of mapping unit 253 characteristically occur on gently sloping to moderately steep residual uplands. These loams to sandy loam soils have a moderate erosion potential, shallow to moderately deep depths, and low to moderate inherent fertility, making them poor to fair sources of topsoil material.

Soils of mapping unit 254 characteristically occur on nearly level to gently sloping slopes adjacent to upland drainageways. These loamy soils have a low to moderate erosion potential, moderately deep to shallow depths, and excess sodium in the Bullock portion (45%) of the unit, making them poor sources of topsoil material.

Soils of mapping unit 210 characteristically occur on nearly level and gently sloping alluvial fans, terraces, and drainageways. These loam to clay loam soils have a low to moderate erosion hazard, deep depths, and subsoil sodium in the Ravalli portion (30%), making them fair to good sources of topsoil material.

The flood plain soils in mapping unit 257 in the Big Ditch drainage would not be considered an alluvial valley floor locale since these soils are undeveloped rangelands not significant to farming.

The distribution of soil units within the project area is illustrated in Map HS2-1. A soil use interpretations summary for these mapping units is shown in Table HS2-1.

Tables of detailed soil use interpretations for the mapping units are shown in the Hanna South Appendix. Descriptions of these Order III mapping units are also given in the Hanna South Appendix.

WATER RESOURCES

Where?

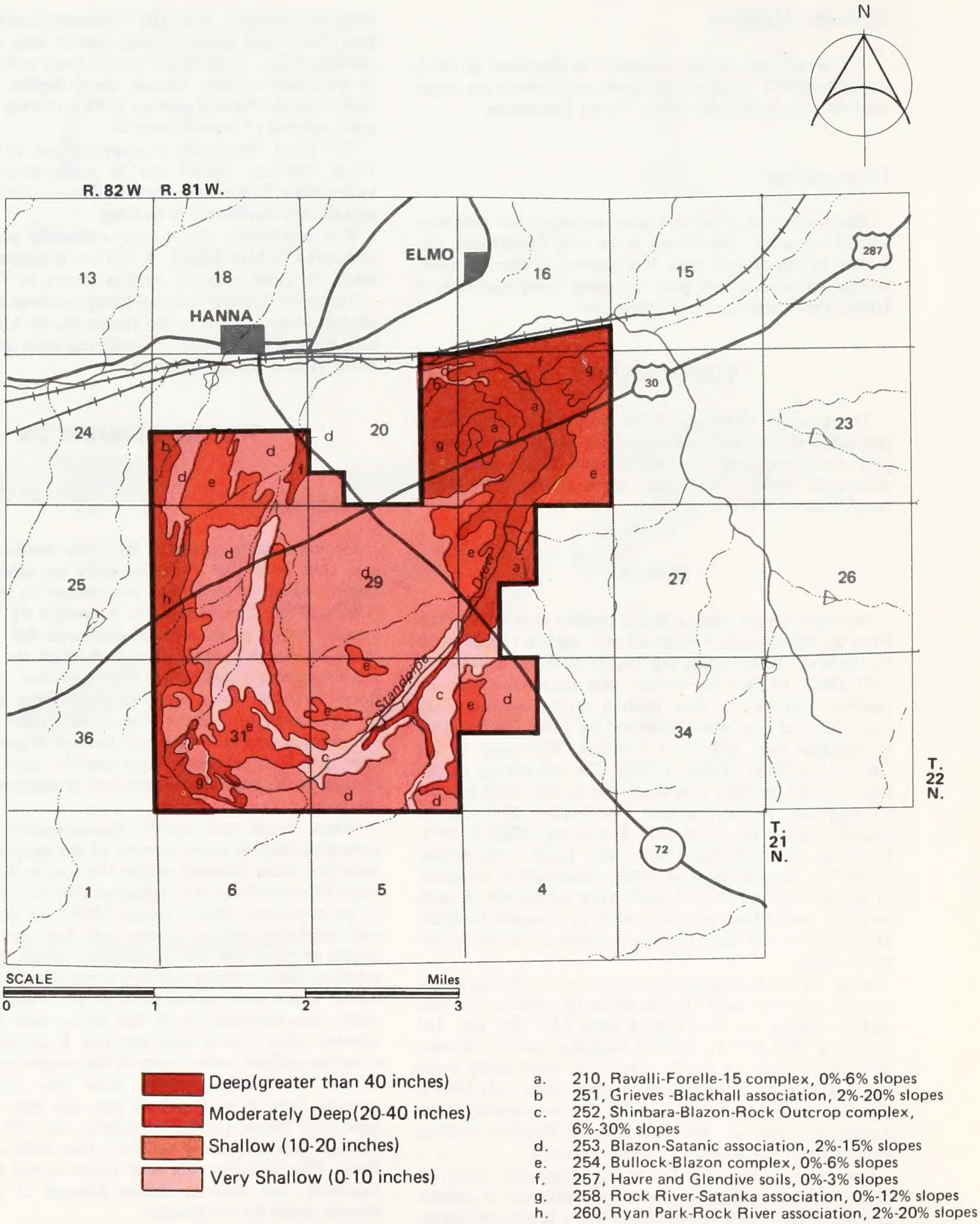
Groundwater

Geologic strata consist of lenticular sandstones, shales, and coal beds that form basically an artesian aquifer system which is recharged somewhere to the southeast (Davis 1976b) (See Map 6B in Appendix A). The project appears to be in an area of discharge for this system. Some discharge probably occurs through the alluvium of Big Ditch and is lost by evapotranspiration on the valley floor. Artesian water probably crosses the site to wells in, and north of, Hanna. The groundwater gradient in the project area is northward, toward Hanna and averages 100 feet per mile. Topographic maps show two springs in the project area and two immediately north of the area.

Water levels and aquifer characteristics have been measured only in three corners of the project area. (No data have been obtained within the area to be mined, but Arch Mineral Corp. has registered five test wells that are to be completed about August 1978.) At the southwest and northeast corners, water was first encountered at depths of 95 to 115 feet below land surface. Water levels resulting from artesian pressure stood 65 to 70 feet above where water was encountered. In the southeast corner, water was encountered 26 feet below land surface and artesian water flowed from the well. It appears that little to no unconfined water exists in the project area.

The water-bearing strata have low permeabilities, ranging from 2 to 6 gallons per day per square foot (gpd/ft^2). Davis (1976b) estimates that 70 gpd flows through each section of aquifer 1 foot wide and 100 feet thick. This indicates that well yields would be minimal. However, one well in Hanna delivers 25 gallons per minute (gpm) for stockwater.

Surface Water



Map HS 2-1

SOILS
Hanna South

Table HS2-1

SOIL INTERPRETATION SUMMARY - HANNA SOUTH

Soil Unit		Erosion Hazard Potential[1]		PSIAC[2]			Suitability for Final Cover for Mined Land[3]		Range Site[4]	Capability Group[4]		Estimated Acres in Project Area		Vegetative Type[5]
Symbol	% Slopes	Water	Wind	Rating	Ac Ft/SqMi/Yr	Ton/Ac/Yr	In. Avail.	Suitability		Dryland	Irrigated	Acres	Percentage	
210	0-3	L	M	24-29	0.20-0.24	0.6-0.8	14-60	M-H	Saline Upland	VIIs	VIs	408	9.9	14, 1
	3-6	M	M						Loamy	VIe	IIIe			
251	2-6	M	M	27-37	0.18-0.31	0.6-1.0	4-60	L-H	Sandy	VIe		37	0.9	4
	6-15	M	H						Sh. Sandy	VIe				
	15-20	H	H											
252	6-15	M	M	51-61	0.52-0.74	1.7-2.4	0-6	L	Sh. Loamy	VIe		426	10.3	4
	15-20	H	M						Very Shallow	VIIs				
253	2-6	M	M	37-47	0.31-0.45	1.0-1.4	6-27	L-M	Sh. Loamy	VIe		1,897	46.0	4
	6-15	M	M						Loamy	VIe				
254	0-3	L	M	32-27	0.18-0.22	0.6-0.7	6-10	L	Impervious Clay	VIe		704	17.1	4a
	3-6	M	M						Sh. Loamy	VIe				
257	0-3	L	M	14-19	0.13-0.16	0.4-0.5	30-60	M-H	Lowland	VIe	IIIe	170	4.1	14, 1
									Lowland	VIe	IIIe			
258	0-3	L	M	24-32	0.20-0.27	0.6-0.9	17-60	M-H	Loamy	VIe		328	7.9	4
	3-6	L	M											
	6-12	M	M						Loamy	VIe				
260	2-6	L	H	26-33	0.21-0.27	0.7-0.9	26-60	H	Sandy	VIe		157	3.8	4
	6-15	M	H											
	15-20	H	H						Loamy	VIe				

Table HS2-1

SOIL INTERPRETATION SUMMARY-HANNA SOUTH
(Continued)

1. Erosion hazard classes or susceptibility of the soil to erosion when no cover is present from BLM 7317.1 and soil profile descriptions in USDA, SCS 1978, 1977, 1976, and 1972. L--Low (Slight) M--Moderate H--High (Severe).

2. Estimate present erosion rates (Pacific Southwest Inter-Agengy Committee 1968).

3. Estimated soil suitability for reclamation of mined land (BLM 7312); L--Low (Poor), M--Moderate (Fair), and H--High (Good).

4. Soil survey legend and interpretations and mapping unit descriptions SSA630 (January 1978).

5. Vegetative types adapted to and likely to occur on soil types (see Vegetation section).

Source: BLM 1978

Where

DESCRIPTION OF THE ENVIRONMENT

The project area is drained by Standpipe Draw, its small tributaries, and other tributaries to Big Ditch (Map HS2-2). All are ephemeral and flow only 5 to 10 days per year. Standpipe Draw flows through the center of the area proposed for the largest of three pits. At the pit site the drainage area is about 2.5 square miles (mi^2); at U.S. Highway 30, where the GS has measured peak discharges since 1959, the drainage area is 7.4 mi^2. The streams on the site are basically ephemeral, but there are short reaches of intermittent spring flow, which are quickly lost through evapotranspiration. Gully erosion is predominant throughout the upper tributaries.

Westinghouse (1976d), computed the runoff and peak discharges of Standpipe Draw for various probabilities of a 6 hour storm occurrence using methods developed by the Soil Conservation Service. The discharges by Westinghouse are less than the corresponding ones computed from streamflow data collected at U.S. Highway 30 and from recently developed relations that apply directly to Wyoming streams (Lowham 1976). The results of the three methods are compared in Table HS2-2. The mean discharge at the highway from curves by Lowham (1976) is 0.7 cubic feet per second (cfs) or 250 acre feet per year.

Quality

Groundwater quality across the project area varies widely. Water samples from wells HS1 and HS2 (Map HS2-2) also indicate a marked variation in quality in a vertical direction. Water in HS2, which draws water from a depth of 240 feet, has much poorer quality water than HS1, which draws water from a depth of 130 feet. Water from the deeper well had a concentration of 9,160 milligrams per liter (mg/l) of total dissolved solids (TDS); whereas, the shallower one had a concentration of 1,960 mg/l. The only potable water was found in HS3, a flowing well, which had TDS concentration of 470 mg/l. Alkalinity of the five area wells ranged from 291 mg/l to 582 mg/l. Water in the area is high in iron, having concentrations ranging from 16 to 131 mg/l, far in excess of the .3 mg/l recommended by the Environmental Protection Agency for domestic water supplies.

The Energy Research and Development Administration is conducting an experiment on in-situ coal gasification within the Hanna South project. Davis (1976b) states that experimental operations could possibly release contaminants to the groundwater system, but there is little probability that the operation has caused a significant change in the general quality of groundwater. Aquifers of the experimental site are isolated from the regional aquifer system. There is too little water moving under the site to transport contaminants. Most of the water under the site was used during the first experimental burn making it necessary to add water if additional burns are made (personal communication GS, WRD).

Surface water is high in dissolved solids and in sediment. Because of the ephemeral character of flow, there is great variability with time and place. In general, quality is best during periods of snowmelt; sediment transport is greatest during the short, sharp peaks that follow heavy rainstorms. Water is suitable for use by wildlife and livestock and for irrigation.

Short-term sediment loads can be high. For example, the 50-year instantaneous flood peak (one having a 0.02 probability of occurring in a given year) for Standpipe Draw at U.S. Highway 30 is estimated at about 700 cfs. If sediment concentration were 50,000 mg/l (a reasonable estimate in this environment), the peak transport rate would be at a rate of about 93,000 tons per day for a period of a few minutes, but the transport rate would drop rapidly to zero as discharge decreased. The total load during a 50-year flood would be on the order of 3,000 to 4,000 tons or 20 to 25 ac/ft during a 2 hour runoff event. Sediment yield from smaller parts of the basin would be proportionately less.

Water Use

The major use of water is for watering stock and wildlife. Two stockwater reservoirs exist in the project area and there are five others just outside the boundary. The only adjudicated surface water right within the project area involves a pipeline, which brings water across the property from Elk Mountain for the city of Hanna water supply. The sources of water are springs on the west side of Elk Mountain. Two open reservoirs, one of which is within the property boundaries, are used for settling and/or pressure equalization.

VEGETATION

Terrestrial

The vegetative cover on the Hanna South project area is composed of four vegetative types. For a general description of these types, refer to the descriptions presented in the Regional Analysis, Chapter 2, Vegetation Section. The geographic locations of range types on the project area are shown on Map HS2-3. The acreage and percent distribution are shown in Table HS2-3.

Big Sagebrush

In the big sagebrush type, Wyoming big sagebrush occurs in uniform age-height stands on a variety of soils and range sites. This species commonly occupies the non-salty bottom areas, east-facing range sites, and wind-protected pockets where deeper soils and above average moisture conditions exist. Big sagebrush average between 3 and 4 feet high and comprise an average cover between 20% and 40% (often exceeding 60%), on bottomland sites and along drainages.

Understory species on bottomland sites differ from upland sites. The bottomland sites include such understory species as Kentucky bluegrass, Canby bluegrass, and basin wildrye. Thickspike wheatgrass, Sandberg

200 AF/Y
from 7.4 mi²

Spring

Stock Reservoir

Crest Stage Gage

Test Well

Proposed Floor Control Dam

Main Supply Line for Hanna Water System

Map HS 2-2

WATER RESOURCES
Hanna South

Table HS 2-2

DISCHARGES ASSOCIATED WITH VARIOUS STORM PROBABILITIES

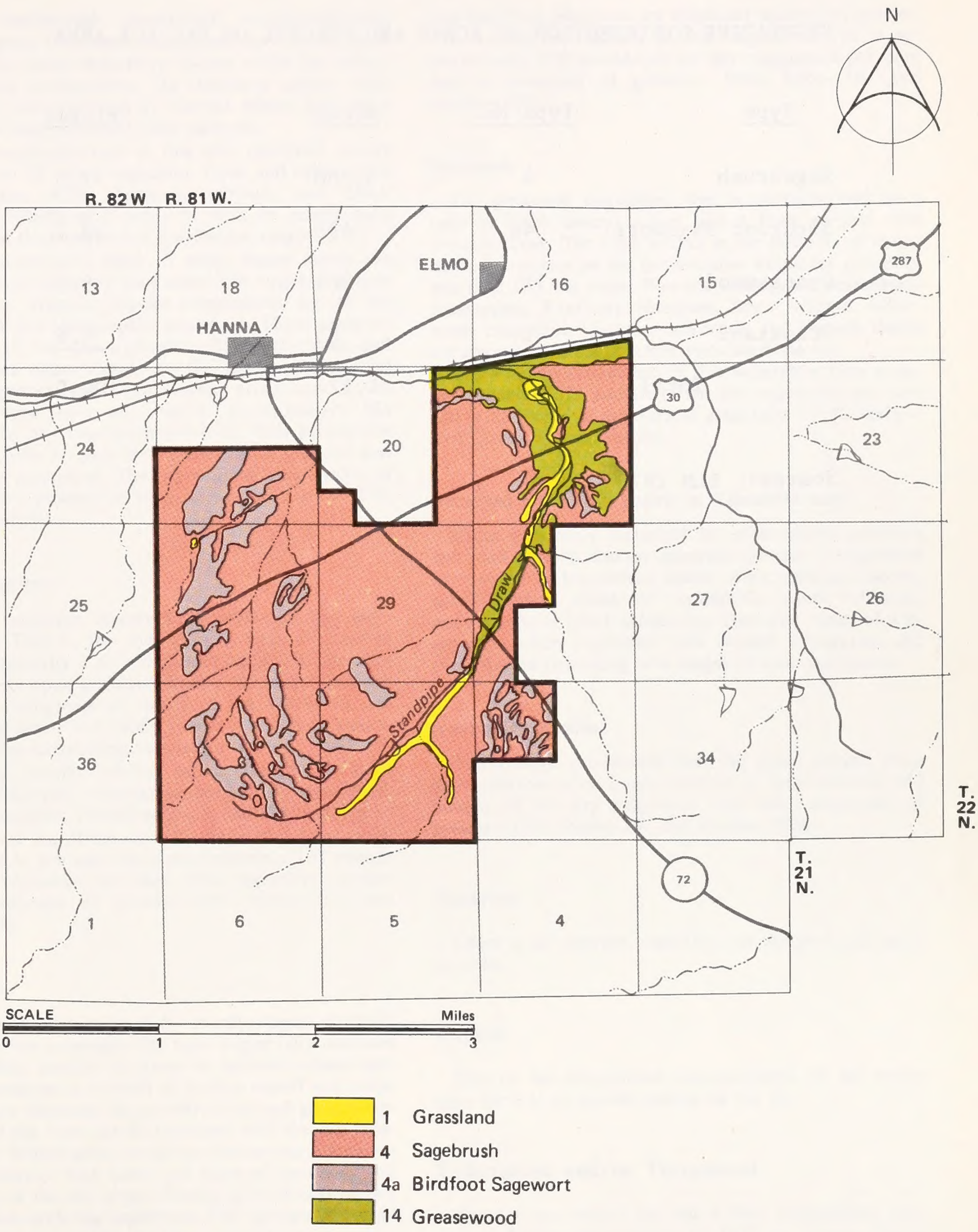
Probability of Storm or Peak	Runoff in Acre Feet*	Peak Discharge In cfs		
		Westinghouse	Lowham**	Measured Data***
0.1	10	40	300	400
.02	54	230	700	650
.01	101	300	1,000	750

*Computed by Westinghouse (1976 using SCS method and an apparent drainage area of 6 mi^2).

**Computed from curves by Lowham (1976) for site at U.S. Highway 30 having a drainage area of 7.4 mi^2. To obtain corresponding values at upstream pit site multiply listed values by 0.7.

***From Log Pearson Type III Analysis of peak flow data collected at U.S. Highway 30.

Source: BLM



Map HS 2-3

VEGETATIVE MAP
Hanna South

Table HS2-3

VEGETATIVE DISTRIBUTION BY ACRES AND PERCENT ON PROJECT AREA

Type	Type No.	Acres	Percent
Sagebrush	4	3,200	77.5
Birdfoot Sagewort	4a	498	12.1
Greasewood	14	364	8.8
Grassland	1	65	1.6
Total		4,127	100.0

Source: BLM 1978

bluegrass, bottlebrush squirreltail, needleandthread, Indian ricegrass, bluebunch wheatgrass, and Hoods phlox constitute the major understory species within the upland big sagebrush communities. On shallower upland soils, this type is characterized by shorter plants and more widely dispersed individual plant patterns.

The big sagebrush type in this area generally occurs contiguous to all other vegetation types and often exists in association with shadscale saltbush and black greasewood which also occur in pure or nearly pure stands within their respective distribution ranges.

On the moderately steep to steep slopes above the drainages, shallow rocky soils exist. The vegetative type has a mixed, irregular species composition due to the variable soil and topographic sequences. These areas include most of the grass, grasslike, forb, half-shrub, and shrub species characteristic to the big sagebrush and birdfoot sagewort types. The average production of this vegetative type over all sites is approximately 688 pounds of air dry vegetation per acre. This production varies from year to year with variances in climatic and soil moisture conditions. The approximate composition of the vegetative production is: grasses—17%, forbs—1%, and shrubs—82%.

Birdfoot Sagewort

Birdfoot sagewort commonly borders the big sagebrush type. Due to the low growth form of birdfoot sagewort (generally 2 to 3 inches in height) it often appears to be an open grassland from a distance. Although commonly contiguous to stands of big sagebrush and shadscale saltbush, it is rarely found mixed or in association with the surrounding vegetation types.

Dominant species within stands include birdfoot sagewort, thickspike wheatgrass, bottlebrush squirreltail, Sandberg bluegrass, Nuttall saltbush, and Hoods phlox.

Due to past use of the area, the vegetative production on this type is low and totals approximately 160 pounds of air dry vegetation per acre. This vegetative production is composed of grasses—19%, forbs—1%, and shrubs—60%.

Greasewood

This type is characterized by evenly dispersed plants from 2 to 4 feet in height. The type is generally confined to saline soils, usually in draws or bottoms where salts have accumulated as a result of surface runoff and evaporation. At a distance, the growth form and general appearance of the type can be confused with the big sagebrush type. Where saline or saline-alkaline conditions are not exceptionally high (near the head of drainages and along sides of the the larger draws), greasewood occurs in association with big sagebrush. The greasewood type is commonly bordered by the big sagebrush type.

Understory species composition varies within the same drainage and from one drainage to another. The number of species is limited to those with a high tolerance to saline soil. Western wheatgrass, thickspike wheatgrass, and Sandberg bluegrass are dominant understory species. The average production of this vegetative type is approximately 870 pounds of air dry vegetation per acre and is composed of grasses— 19%, forbs—1%, and shrubs—80%.

Grassland

The grassland vegetation type is characterized by a lack of shrub canopy cover and a high percent total ground cover. The type occurs in the bottoms of major drainage systems on the project area which are generally less than 100 feet wide. Western wheatgrass, streambank wheatgrass, Kentucky bluegrass, basin wildrye, silverweed cinquefoil, longstem spikerush, and Canada thistle are among the most common associated species.

The average production of this vegetative type is approximately 1,375 pounds of air dry vegetation per acre and is composed of grasses and grass likes—71%, forbs—29%, and a trace of shrubs.

Disturbed Lands (not shown on Vegetative map)

Areas previously disturbed by mine-related activities and road construction are generally devoid of vegetation or covered with scattered stands of successional species, usually annual weeds or undesirable plants indicating early stages of plant succession. Highway rights-of-way are most often vegetated with crested wheatgrass and plant species indicating later stages of plant succession.

Average Production

The average production over the entire project from all vegetative types is estimated to be approximately 660 pounds of air dry vegetation per acre, composed of grasses—19%, forbs—2%, and shrubs—79%.

Riparian

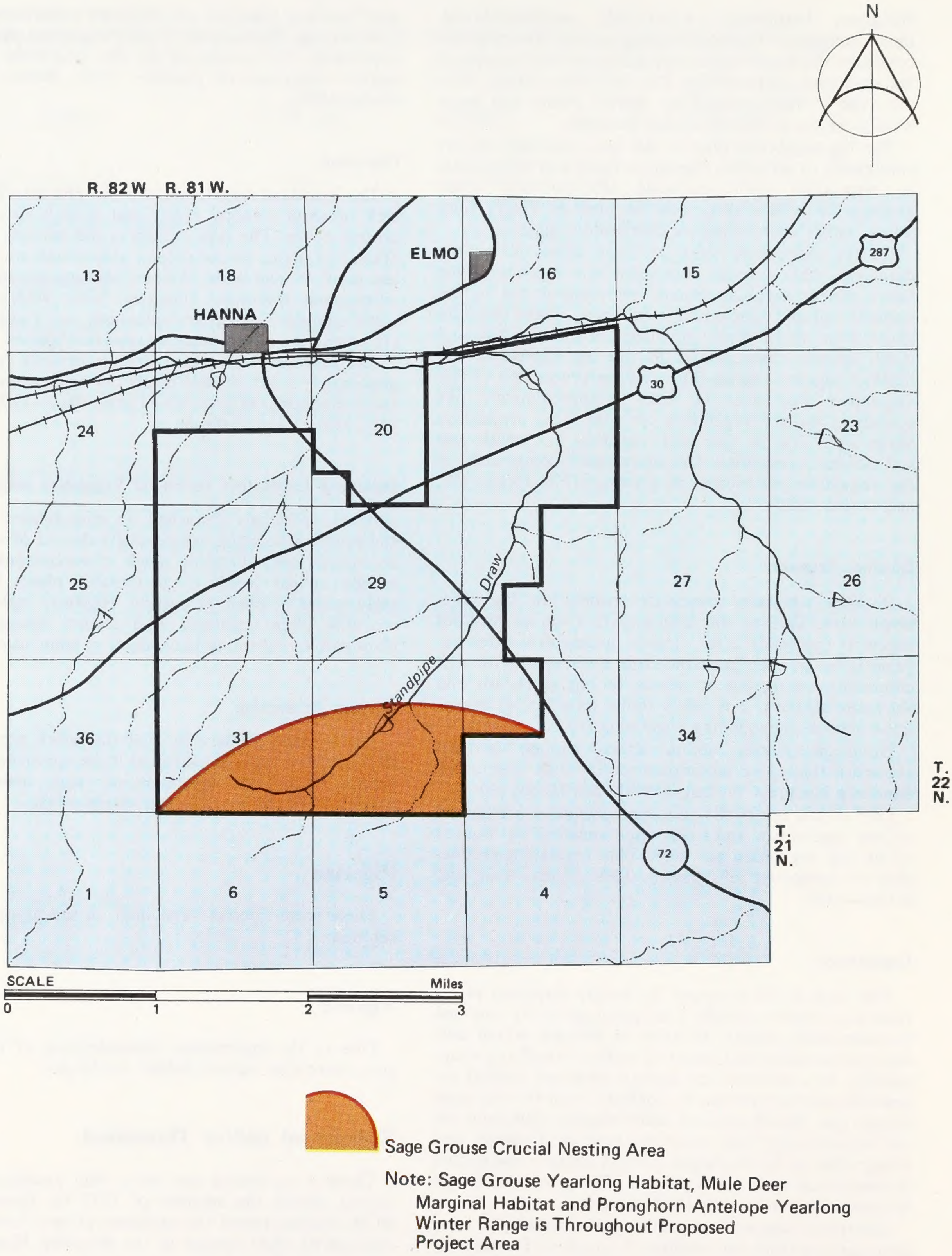
There is no riparian vegetation on the proposed project area.

Aquatic

Due to the intermittent characteristics of the drainages, there is no aquatic habitat on the site.

Endangered and/or Threatened

There is no record nor did a field examination conducted during the summer of 1977 by Robert Dorn, BLM botanist reveal the existance of any threatened or endangered plant species in the proposed Hanna South project area. Due to the soil types that exist in the area, it was concluded that the chance of any threatened or



Map HS 2-4

WILDLIFE HABITAT
Hanna South

endangered plants being present is near zero (refer to Regional, Chapter 2, Vegetation, Endangered and/or Threatened).

FISH AND WILDLIFE

General Information

Habitat Types

Major habitat types that occur on the project area and the primary species of wildlife that occur in these types are listed below. A listing of wildlife species that could occur on the project site can be obtained from the Rawlins District Office of the BLM.

Aquatic

There is no aquatic habitat on the proposed mine site. All streams in the project area are ephemeral. Two springs and one stock watering reservoir furnish water for both wildlife and domestic livestock. The springs and reservoir do not furnish water on a year-round basis.

Terrestrial

Sagebrush (3,200 acres). The sagebrush vegetative type supports a diversified number of animals including pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, coyote, longtail weasel, least chipmunk, Unita ground squirrel, deer mouse, Great Basin pocket mouse, sage grouse, sage sparrow, Brewer's sparrow, vesper sparrow, horned lark, sage thrasher, and Brewer's blackbird.

Birdfoot Sagewort (498 acres). This vegetative type supports much the same species list of wildlife as appears in the sagebrush type listed above.

Greasewood (364 acres). The greasewood type will generally support the following species of wildlife; pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, coyote, deer mouse, least chipmunk, Unita ground squirrel, sage thrasher, Brewer's sparrow, horned lark, and Brewer's blackbird.

Grassland (65 acres). The grass vegetative type supports much the same types of wildlife as other vegetative types in this area; pronghorn antelope, mule deer, coyote, desert cottontail, whitetail jackrabbit, deer mouse, Great Basin pocket mouse, Unita ground squirrel, least chipmunk, sage grouse, horned larks, sage thrasher, Brewer's sparrow, vesper sparrow, and Brewer's blackbird.

General. Several species of raptors may be seen using the project area as hunting habitat. Some of the more commonly observed species are the Swainson's hawk, red-tailed hawk, American kestrel, marsh hawk, and golden eagle.

Fishery

There is no fishery existing on the proposed Hanna South Mine project area.

Wildlife

Introduction

The major vegetative habitat types found on the project area are sagebrush (3,200 acres), birdfoot sagewort (498 acres), greasewood (364 acres), and grassland (65 acres).

Birds

Nongame. The primary songbird and small nongame bird species are listed under the various habitat types at the beginning of this section. A search of the literature and consultation with personnel of the U.S. Fish and Wildlife Service from the Denver Wildlife Research Center indicates that there are between 30 and 40 species of small birds associated with the vegetative types on the project area. These various species would have an average breeding density of from 8 to 40 pairs per 100 acres (personal communication, Max Schroeder, USFWS, April, 1978). These numbers could be significantly changed as migratory birds species come and go through the area.

A raptor survey conducted by the Wyoming Game and Fish Department in 1977 did not identify any raptor nests on the project area. Topography of the area does not lend itself to cliff nesting raptors, but the potential does exist for ground nesting raptors such as marsh hawks.

Game. The entire project area is classified as year-round habitat for sage grouse. A strutting ground or lek that has about 8,000 acres of crucial nesting habitat associated with it is located south of the project area. Of these 8,000 acres, 479 are located in the southern portion of the project area, comprising about 9% of the total crucial nesting habitat in the general area (see Map HS2-4).

Mammals

Nongame. The major small nongame mammals inhabiting the project area are the least chipmunk, Unita ground squirrel, Great Basin pocket mouse, deer mouse, desert cottontail, and whitetail jackrabbit. There are at least 23 species of small mammals that could occur on the project area according to literature sources (Burt and Grossenheider 1976).

Game. The entire project area (4,127 acres) is classified as year-round/winter range for pronghorns by the Wyoming Game and Fish Department (see Map HS2-4). Despite the habitat designation, few pronghorn winter on the site (approximately twenty animals). The occurrence

of these animals fluctuates at various times during the winter. There is no crucial pronghorn range on this area.

The project area supports only a small population of mule deer, rarely exceeding five animals. The deer habitat provided on the area can be classed only as marginal deer range (see Map HS2-4). There is no crucial deer habitat on site.

Desert cottontail rabbits are common throughout the project area. Density estimates for this species are lacking at the present time.

Reptiles and Amphibians

General

Reptile and amphibian numbers are low at best on the project area. Some of the species that could occur on the site are sagebrush lizards, northern shorthorned lizards, northern sideblotched lizard, and the western rattlesnake. There is little riparian vegetation and free water on the site which would provide habitat for any kind of amphibian.

Feral (Wild) Horses

No feral horses are found on the proposed project area or in the immediate vicinity.

Endangered and/or Threatened

Since there is one whitetail prairie dog colony on the southern boundary of the project area, the possibility of black-footed ferrets occurring on the site cannot be discounted.

No endangered or threatened species of birds are known to exist on or near the project area, but there is a possibility that the project area may be used by migrating bald eagles and peregrine falcons.

There are no known threatened or endangered fish, reptiles, or amphibians known to exist on the proposed project area.

CULTURAL RESOURCES

No sites in the Hanna South project area are currently listed on the Wyoming Historic Preservation Plan or on the National Register of Historic Places.

Archeological

The entire Hanna South project area was surveyed by the University of Wyoming (in 1977 and 1978). Eight sites were located within the project boundaries for an average site density of 1.25 sites per section. Three additional sites were located outside, but within 1 mile of the project boundaries. See Table HS2-4 for a listing of site types found in the project area.

Of these eleven sites, five have been tested and fully evaluated. This testing established that the available cultural information had been recovered and that the sites are of no further significance. National Register eligibility of the remaining six sites would not be established until further testing is done. The State Historic Preservation Officer will be consulted to establish the significance of these sites.

The potential for subsurface sites also exists within the entire project area, particularly in areas of windblown or alluvial deposits.

Historical

One site located appears to have components associated with the early mining history of Hanna. It was determined not to be eligible for nomination to the National Register of Historic Places.

VISUAL RESOURCES

A visual resources classification was conducted by the Bureau of Land Management (BLM) on and adjacent to the project area using BLM visual resource inventory and evaluation procedures as explained in BLM Manual 6300 and Appendix B. Map HS2-5 illustrates the classification zone.

The visual management class that has been identified within the project area is Class III which covers the entire 4,127 acre project area.

The characteristic landscape (Figure HS2-2) of the project area is also typical of adjacent land. The land consists of low rolling terrain covered with low growing sagebrush, mountain shrub, and greasewood. The principal drainage feature in the area is Standpipe Draw, an ephemeral stream with very little scenic value.

The project area is crossed by two major highways, U.S. Highway 30 and State Highway 72, unimproved dirt roads, a telephone cable, a pipeline, three power lines, and several fences. These intrusions can be seen throughout the project area and reduce the value of the management class. A good view of the project area can be seen from practically any location on the highways which pass through the site. The roads have high year round use and are of importance to the visual sensitivity. The most significant viewpoints are indicated on Map HS2-5.

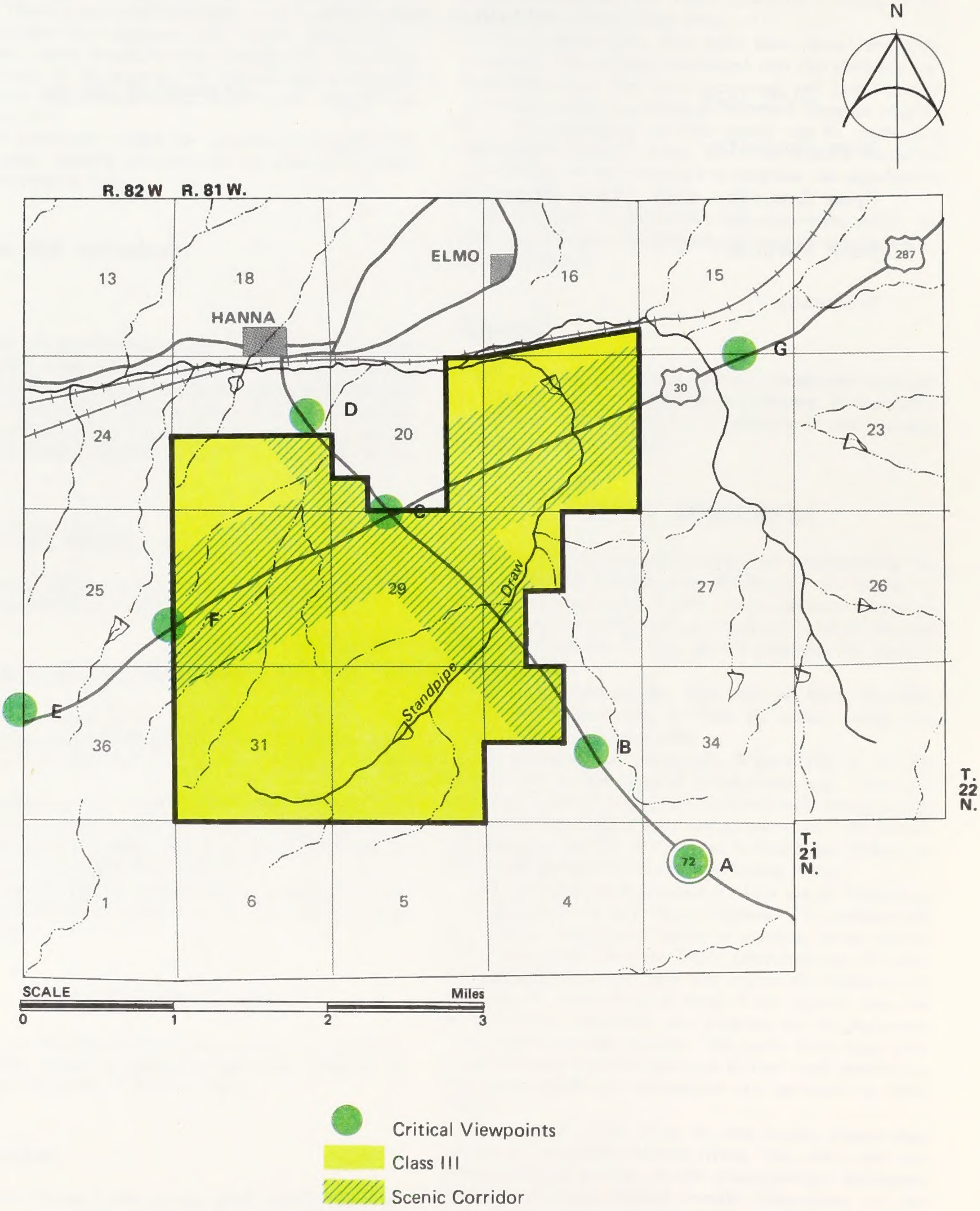
Management of the Class III area would require that changes in the basic elements (form, line, color, and texture) could be evident in the characteristic landscape; however, changes should remain subordinate to the visual strength of the existing landscape character.

RECREATION RESOURCES

Table HS2-4

CULTURAL RESOURCES

Site Type	Number of Sites
Open Campsite	8
Open Campsite with stone ring	1
Rock Shelter	1
Townsite	1



Map HS 2-5

VISUAL RESOURCES
Hanna South

Figure HS2-2

CHARACTERISTIC LANDSCAPE OF HANNA SOUTH--FROM STATE HIGHWAY 72

Visitor Use Data

Table HS2-5 depicts the estimated visitor use by activity in the proposed project area.

Hunting

During the summer, incidental hunting is limited to rodents. In late summer the hunting season begins to draw hunters to the field. This area supplies primarily sage grouse and antelope populations for hunting purposes. Deer hunting is very limited.

Rabbit hunters travel to the area to pursue cottontails, normally after the big game and bird hunting seasons are over. This season lasts from early fall until the end of February.

In recent years the value of coyote hides has increased substantially from approximately $35 for a prime hide in 1975 and 1976 to $65 in 1977. This has encouraged people to hunt and trap the area for coyote.

Off-Road Vehicles

There are several mineral exploration and ranching associated roads located in the project area. These roads are used extensively by persons with four-wheel drive vehicles during the hunting season.

Wilderness Values

There are no roadless areas in or near the proposed project area with identified wilderness values which meet the criteria set in Section 603 of the Federal Lands Policy Act of 1976.

Sightseeing

Most of the sightseeing use in the area can be considered incidental as people travel along State Highway 72 and U.S. Highway 30.

AGRICULTURE

Livestock Grazing

The Hanna South project area is located in the Dana Meadows South grazing allotment. The allotment contains 36,827 acres and involves two ranch operations. Sheep graze the allotment under yearlong management systems for a yearly use of approximately 5,491 animal unit months (AUMs). Cattle graze on the allotment during the spring, summer, and fall seasons for a yearly use of approximately 102 AUMs. The project area covers 4,127 acres, or approximately 11% of the allotment area, and has a grazing capacity of approximately 413 AUMs.

U.S. Highway 30 and Wyoming Highway 72 intersect near the center of the project area and divide the allotment into four parts in this area. Approximately 14 miles of fence bordering each side of the highways are located within the project boundary. Due to the divisions of the allotment, each portion of the project area is grazed at different periods of time. One stockwater reservoir is known to exist on the area to be mined, and one lies adjacent to the project area. In addition, two springs lie within the project area.

Farming

There is no cropland located within the proposed project area.

MINERAL RESOURCES

Coal

The coal seams of interest at this proposed mine are Seams 77, 78, 79, and Hanna No. 1, of the Hanna Formation. The four seams average 5.1, 8.0, 9.4, and 18.7 feet thick, respectively.

In-place reserves are stated by the company as 7.3 million tons and recoverable reserves as 6.1 million tons. Analyses of the four seams are shown in Table HS2-6.

Sand and Gravel

The nearest known deposits of sand and gravel are located north of the project area along the North Platte River, and south of the project area along the Interstate (see Map 13 in Appendix A). Reserves or suitability for concrete aggregate are not known.

Scoria

Scoria deposits have not been identified within the project area. Deposits north of Hanna could be utilized for road construction (see Map 13 in Appendix A). Reserves are not known.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

A large number of separate governmental agencies exercise certain types of land and resource use controls in Carbon County. The Hanna South project area includes public, state and private lands. The federal sector includes the Bureau of Land Management (public lands and mineral estate under certain private lands). Develop-

Table HS2-5

ESTIMATED VISITOR DAYS BY ACTIVITY IN THE HANNA SOUTH AREA

Activity	Visitor Days
Hunting (big game)	24
Sightseeing, incidental	3,505
Off-Road Vehicle	30
Total	3,559

Note: Visitor day considered to be 12 hours.

Source: BLM 1978; Wyoming Game and Fish Department; University of Wyoming

5.1
8.0'
9.4'
18.7'
41.2' coal

Table HS2-6

COAL ANALYSES - HANNA SOUTH

	BTU	MOISTURE %?	ASH ?	SULFUR ?
Bed 77	9,880	9.56	19.90	1.42
Bed 78	10,085	12.18	15.19	0.89
Bed 79	9,941	12.53	15.83	1.15
Hanna #1	10,288	11.47	13.77	0.73

ment, management, use, and control of use on these public lands has been delegated to this agency.

Controls are effected through issuance or nonissuance of a variety of leases, permits, licenses, etc. Each authorization to use public lands contains provisions to control that use. Controls exercised by the federal government for the subsurface estate are governed by the statutes authorizing the disposition and use of that estate. Foremost among these statutes is the authority for leasing coal deposits and authority to require, as a condition of such leases, an operation-management plan and a reclamation-restoration plan. Management policy has been extended in greater detail by the National Environmental Policy Act of 1969, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. In certain situations, there is a joint or multiagency sharing of particular management and control functions and responsibilities, such as the cooperative agreement between the Department of the Interior and the state of Wyoming that allows the state to administer and enforce reclamation operations on federal leases in Wyoming. The subsurface estate vested in private or state ownership would normally be governed by applicable state of Wyoming statutes.

A number of state agencies have development and administrative authority over state of Wyoming owned lands. Additionally, under state of Wyoming statutes, the state is authorized to perform and administer certain surface land use, planning and development activities on state, county, municipal, and privately-owned properties. Two pieces of legislation passed by the 1975 Wyoming Legislature which could have a significant effect on land use are: The Wyoming State Land Use Planning Act and the Industrial Development Information and Siting Act. The Land Use Planning Act requires completion of county land use plans by 1978, and these plans could conflict with or modify some of the energy proposals. The Industrial Siting Act requires furnishing extensive information and a state permit before certain facilities can be constructed. The impacts of this act would affect developments which include gasification or electric generation proposals. Control does not apply to public properties except as provided by law.

Except where controls have specifically been delegated by statute to counties or muncipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands. Certain of these lands were conveyed to the state as part of the Act admitting Wyoming to the Union. This legislation granted Section 16 and 36 of every township to the state for educational purposes. Use and control of these lands (including mineral leasing, rights-of-way, etc.) is governed by Wyoming law. No lands of this type are within the project area.

Under Wyoming statutes, counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes. The authority does not apply to any planning or zoning controls over lands used or occupied for the extraction or production of minerals.

Control over mineral uses is vested in the state of Wyoming under the Wyoming Environmental Quality Act of 1973. This act also authorized the state to control air quality, water quality, and solid waste management.

Where a county or city lacks a specific authority, provisions of the Wyoming Joint Powers Act are available to enable joint exercise of power, privilege, or authority. This legislation enables two or more agencies to jointly plan, create, finance, and operate (control) water, sewage, or solid waste facilities; fire protection agency facilities; transportation systems facilities; and public school facilities.

Carbon County has developed and adopted a comprehensive plan. Additionally, the county has passed zoning ordinances to control land use.

The Hanna South project area is zoned for ranching, agriculture, and mining; however, there is a scenic highway corridor that extends for a distance of 2,000 feet on both sides of U.S. 30 and State Highway 72, which traverse the site.

Cities have authority to effect a master plan, zoning, and other regulatory controls. Cities do not have statutory authority to effect controls over mineral extraction or production within their corporate limits. Furthermore, the Wyoming Environmental Quality Act of 1973 would preempt cities; authority to regulate and control air, water, solid waste, and land quality standards except where specifically delegated to a municipality.

In summary, all of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

SOCIOECONOMICS

Demographics

Population

The 1977 population of Carbon County was 18,137. The population of Rawlins was 10,500; Saratoga's population was 2,050 and Hanna's population was 1,300 (Table HS2-7).

Employment

Total Carbon County employment was 8,067 in 1977 (Table HS2-8). The 1977 unemployment rate for Carbon County was 3%.

Income

The total 1977 personal income (in constant 1977 dollars) in Carbon County was $147.1 million. The major contributors to this income were mining (28.4%), busi-

Table HS2-7

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

Jurisdiction	1977 Population	Percent of Carbon County Population
Carbon County	18,137	100.0
Rawlins	10,500	57.9
Sinclair	550	3.0
Hanna/Elmo*	1,500	8.3
Elk Mountain	220	1.2
Medicine Bow	750	4.1
Saratoga	2,050	11.3
Encampment	500	2.8

* These towns are located several miles apart and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Institute, Laramie, March 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

Table HS2-8

EMPLOYMENT BY SECTOR - CARBON COUNTY*

Sector	1977 Employment	Percent of Total
Farm	526	6.5
Manufacturing	360	4.5
Mining	1,658	20.5
Construction	715	8.9
Government	919	11.4
Farm & Forest Processing	46	0.6
Railroads	480	6.0
Business Services	1,415	17.5
Consumer Services	1,948	24.1
Total Employment	8,067	100.0

Note: Employment figures shown represent the number of people living in Carbon County who are employed in one or more jobs. This corresponds to the definition of employment used by the U.S. Bureau of the Census.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, 1978.

ness services (19.7%), consumers services (13.5%), and construction (13.5%). Per capita personal income was $6,348 in 1975. Average weekly wages (Table HS2-9) have been the highest in the mining and manufacturing sectors of the economy.

Infrastructure

Private Sector

Total taxable sales in Carbon County were $67.5 million in 1977. Wholesale trade ($7.9 million), retail trade ($46.7 million), and services ($12.9 million) make up this total.

Local Government

Current (1977) assessed values, mill levies, and bonded indebtedness for the region are shown on Table HS2-10. The bond ceiling, which is the maximum amount of debt that a jurisdiction may incur, is based on the assessed value for the current year. Communities may not issue general revenue bonds for greater than 4% of assessed valuation and sewer bonds for an additional 4%. There is no bond ceiling for water bonds. Counties are limited to 2% of assessed value and school districts are limited to 10%.

Housing

There were 6,160 housing units in Carbon County in 1976; 16% were mobile homes. In 1977 there were 3,428 housing units in Rawlins. Of these, 20% were mobile homes (Table HS2-11).

Education

The 1977 school enrollment for District 01 (Rawlins, Sinclair, Baggs, Bairoil) was 2,668. Building capacity in District 01 is 3,368. The 1977 school enrollment for District 02 (Saratoga, Encampment, Hanna, Elk Mountain, Medicine Bow, Shirley Basin, McFadden) was 1,658. Building capacity in District 02 is 2,430 (Table HS2-12). The expenditures per average daily membership (ADM) in District 01 was $1,695 for 1976. In District 02, the expenditures per ADM was $2,554; the statewide average expenditures per ADM was $1,721 (Wyoming Department of Education 1977).

Health Care

In 1977 there were 2,015 people for each physician in Carbon County. The established standard is 1,000 population per physician. The standard for dentists is 1,600 population per dentist, and for registered nurses it is 285 population per nurse. In Carbon County there were 2,587 people for each dentist and 262 for each registered nurse (Wyoming Dept. of Health and Social Services).

Local Services

The Carbon County Sheriff's Office is currently adequately meeting demands and recent increases in workload (drug arrests increased 250% and number of prisoners handled increased 30% in the past year) are not resulting in decreases in the quality of service (Hansen 1978). A significant proportion of the Carbon County Volunteer Fire Department equipment dates from the 1940s and 1950s and is in need of replacement. The major inadequacy of the department is its inability to extinguish major fires requiring chemical or foam equipment.

The major problem with the Rawlins Police Department is inadequate facilities. The department is also considered understaffed and staff turnover because of high wages paid to miners adds to personnel problems (DeHerrera 1978). The largest potential problem in fire protection service in Rawlins is low pressure in the water system, particularly during the summer when demands for water peak. Rawlins' fire protection rating is seven which is considered adequate (Insurance Services Office 1978). Current improvements underway in Rawlins' water system are designed to meet water needs of the city until the year 2000, based on current growth rates (Paris 1978). Rawlins' present sewer system is being improved to correct major inadequacies. These improvements will significantly upgrade the system, however the system will continue to have problems with old, undersized sewer lines that are overloaded and with groundwater seeping into older lines (Yamashiro 1978).

Police and fire protection in Sinclair are both considered adequate. Peak water demands can presently be met. A study is underway to determine future needs resulting from potential population growth.

Turnover in the Hanna Police Department is an ongoing problem since those hired frequently quit to work in the mines. Hanna's fire protection rating is nine which is considered inadequate by the Insurance Services office in Denver, Colorado. Hanna is currently improving its water system to meet current demands.

Elmo has no fire or police department. These services are provided by the town of Hanna and Carbon County. Elmo's water is supplied by Hanna. A 10,000 gallon storage tank has recently been built to solve the town's low water pressure problems.

Elk Mountain's fire protection rating is ten which is considered inadequate (Insurance Services Office 1978). The town's water system is considered adequate only for present needs. Elk Mountain is the only incorporated area in the county that relies on septic tanks for sewage treatment. With the current population, septic tank leachate is not considered a major problem.

Water service has been the most critical problem in the delivery of local services in Medicine Bow. By midsummer of 1978, current improvements to the water system should correct water supply problems. The town's new sewage treatment lagoon is more than adequate to serve current needs. Medicine Bow's fire protection rating is nine which is considered inadequate (Insurance Services Office 1978).

Table HS2-9

AVERAGE WEEKLY WAGE BY NON-AGRICULTURAL SECTOR - CARBON COUNTY

	Year					
Sector	1970	1973	1974	1975	1976	1977	Average Annual Change (1970-76)**
Manufacturing	161.16	187.81	229.69	264.84	312.96	273.15	11.7
Mining	196.22	233.27	269.67	332.75	377.24	389.94	11.5
Contract Construction	139.55	204.38	221.39	241.05	245.85	255.16	9.9
Wholesale Trade	110.58	126.25	177.75	170.04	182.00	191.58	8.7
Retail Trade	70.08	72.96	93.18	114.21	113.44	115.99	8.4
Finance, Ins. & Real Estate	105.82	122.27	142.29	173.01	175.76	188.81	8.8
Trans., Comm., & Public Utilities	146.31	180.30	188.34	232.06	244.53	258.22	8.9
Services, includ. Agriculture, Forestry & Fisheries	65.40	80.33	86.57	98.96	106.30	124.05	8.4

* Based on monthly data for January 1977 through June 1977.

** This is the average annual rate of change (percent) between 1970 and 1976.

Sources: Wyoming Employment Security Commission, Administrative Services Division, Research and Analysis Section, Casper, Wyoming.

Table HS2-10

FINANCIAL CHARACTERISTICS
1977

	Assessed Valuation	Mill Levy (per $1,000 assessed valuation)	Bonded Indebtedness
Carbon County	$188,630,804	12.61	$159,100
Rawlins	14,505,124	14.76	2,993,000
Hanna	1,403,186	11.40	133,000
Elmo	96,933	12.26	144,000
Elk Mountain	202,399	13.00	27,000
Medicine Bow	621,144	8.00	40,000
Saratoga	2,584,955	8.00	282,000
Encampment	528,175	17.28	43,000

Sources: Assessed Valuation, Mill Levy - Wyoming Taxpayers Association, Wyoming Property Tax Rates 1977, Cheyenne, August, 1977

Bonded Indebtedness - Community Budgets and/or phone conversation with clerk.

Table HS2-11

HOUSING IN INCORPORATED AREAS
TOTAL AND BY TYPE
1977

County Community	Total year Round Units	Type of Unit: Single Family	Multiple Family	Mobile Home
Carbon County				
Rawlins	3,428	2,034 (.60)	700 (.20)	694 (.20)
Sinclair	203	198 (.97)	0 (.00)	5 (.03)
Hanna	510	325 (.64)	0 (.00)	185 (.36)
Elmo	77	35 (.45)	0 (.00)	42 (.55)
Elk Mountain	95	70 (.74)	0 (.00)	25 (.26)
Medicine Bow	246	100 (.41)	6 (.02)	140 (.57)
Saratoga	765	477 (.62)	87 (.11)	201 (.26)
Encampment	241	155 (.64)	2 (.01)	84 (.35)
Total Housing In Incorporated Areas	5,747	3,473 (.60)	795 (.14)	1,479 (.26)

Note: Figures in parentheses are the fraction of total housing units. These figures may not add to 100 due to rounding.

Source: Except for the towns of Rawlins, Hanna and Medicine Bow, the data on housing has been taken from Land Use Plans submitted by the communities to the Carbon County of Governments in the fall of 1977. Although the figure on the total housing units in Rawlins was taken from a Land Use Plan, data on the type of housing was estimated from conversations with local officials. Housing figures for Hanna reflect estimates reported by the local town clerk. Total housing units for Medicine Bow reflect the results of a survey conducted by the local high school students in the spring of 1977. Figures on the type of units in Medicine Bow were estimated based on conversations with local officials.

Table HS2-12

PUBLIC SCHOOL CHARACTERISTICS

1977-78

School District School (Grade)	Student Enrollment	Full-Time Equivalent Teachers	Student/ Teacher Ratio	Building Design Capacity
School District #1				
Mountain View (K-6)	368	18	20.4	460
Pershing (K-6)	282	15	18.8	370
Sunnyside-Central (K-6)	465	14	33.2	488
Baggs-Morrow	213	16	13.3	275
Bairoil (K-8)	65	6	10.8	110
Sinclair (K-6)	65	3.5	18.6	140
Rawlins Jr. High (7-8)	387	22	17.6	525
Rawlins High (9-12)	823	47	17.5	1,000
School District #1 Total	2,668	141.5	18.8	3,368
School District #2				
Elk Mountain (K-6)	39	3	13.0	140
Encampment (K-12)	214	14	15.3	300
Hanna (K-6)	276	13	21.2	300
McFadden (K-8)	16	3	5.3	100
Medicine Bow (K-6)	114	7.5	15.2	150
Platte Valley (K-6)	275	16.5	16.6	300
Shirley Basin (K-6)	79	7.5	10.5	140
Beer Mug (1-6)	2	1	2.0	--
Hanna-Elk Mountain Junior-Senior High (7-12)	200	15	13.3	300
Medicine Bow-Shirley Basin Junior-Senior High (7-12)	153	13	11.7	400
Platte Valley Junior High (7-8)	91	6.5	14.0	300
Platte Valley High (9-12)	199	10	20.0	
District #2 Total	1,658	110	13.1	2,430
Carbon County Total	4,326	251.5	16.0	5,798

Sources: Wyoming State of, Department of Education, Division of Planning, Evaluation and Information Services, Fall Report of Staff/Teachers/Pupils/Enrollments 1977, "Statistical Report Series, No. 2", 1977, Cheyenne, Wyoming.

Wyoming, State of, Department of Education, Communications Services, Wyoming Education Directory, 1977-78, Cheyenne, Wyoming, 1977.

Telephone conversations with Hugh Simmons, School Superintendent, District #1, March 22, 1978; and John Tynon, School Superintendent, District #2, March 22, 1978.

Saratoga is in the process of making improvements to its water and sewer systems. These improvements allowed the town to lift a 15-month moratorium on building caused by inadequacies in its water system. The town's sewage lagoon, however, cannot adequately treat the amount of sewage generated by the town and its currently operating at about 105% of capacity. Police and fire protection are adequate to meet the community's needs.

Water supply is a major problem in Encampment. Water shortages resulted in a building moratorium between July and October 1977. Other local services are adequate or more than adequate to serve present needs.

Transportation and Utilities

Interstate 80, which is one of the prinicpal interstate routes crossing the United States, is the most heavily traveled road.

A major Union Pacific railroad main line passes through southcentral Wyoming. In 1977 freight traffic through Rawlins averaged 50 trains per day carrying a wide variety of products between eastern and western markets. In addition, current coal production in the Hanna Basin added 42 trains per week (loaded and empty return) to transport coal to market.

Amtrak provides passenger railroad service from Rawlins east and west. There is one eastbound and one westbound train daily.

There are four airports in Carbon County. The Rawlins airport runway is paved; its length is 5,500 feet. The Saratoga airport runway is also paved, with a length of 8,400 feet. Regularly scheduled air service is provided to these airports by Trans Mountain Airlines. The other two airports, located just outside Hanna and Dixon, have unpaved runways and are used only by private planes (Donnelly Corporation 1978).

Interstate bus service is available on a daily basis. The bus depot in Rawlins is served by Continental Trailways, Greyhound, Central Wyoming Transportation, and Zanetti Bus and Fast Express (Russel's Railway and Motor Bus Company Guide 1977).

Carbon County is served by four electric utilities; Pacific Power and Light, Carbon Power and Light, Hot Springs REA, and Yampa Valley Electric.

Northern Gas and Mountain Fuel Supply Company distribute natural gas to the county.

Attitudes and Expectations

The attitudes reflected in this section were derived from the Hanna and Overland Planning Unit Planning Area Analyses and some limited opinion surveys that have been completed in the region.

General Attitudes

In 1975, T.A. Bougsty sampled opinion of residents in the Hanna Basin. This study, done for the Wyoming State Department of Economic Planning and Development, explored residents' preference on the size of their communities and satisfaction with various community services. It was found that 73% of the residents of Elk Mountain prefer no growth, while residents of Hanna and Elmo would tolerate some growth. Satisfaction with community services varied somewhat between communities and the Basin as a whole, with medical services, natural gas supply, streets and roads, community beautification, and recreation facilities being those services the residents were most dissatisfied with.

Information regarding the attitudes of residents in other areas of the Hanna Planning Unit is not presently available.

A resident survey covering the Overland Planning Unit was done in 1976 by Bickert, Browne, Coddington, and Associates. Among other things, residents were asked to rate adequacy of various community services. The results showed that only five services were rated 'very adequate' by 10% or more of the sample. These were fire protection, schools, utilities, roads and highways, and trash disposal.

Specific Attitudes

The following attitudes were derived from material contained in the Overland and Hanna Planning Area Analyses:

1. Forest Management: The timber industry, including the Wyoming Wood Producers Association, supports a continued timber sale program: large sales are desired.
2. Access: Hunting and recreation groups strongly support a program to obtain access in checkerboard land areas and other areas where private lands block access to public lands. Groups such as the Carbon County Conservation Club and the Wyoming Game and Fish Department support programs to obtain access.
3. Livestock organizations support a freeze or cutback of grazing fees on public lands. Most operators desire to have increased flexibility with respect to use of grazing allotments, in terms of class of stock, numbers of stock, season of use, etc. Most operators favor predator control and strongly favor management of wild horses and return of wild horse numbers to 1971 levels.

Lifestyles

The ongoing change in the lifestyles of the population residing in the areas associated with the Hanna South project are the same as those occurring in the region as a whole. Please refer to the Regional, Chapter 2, Lifestyles for a complete description of these changes.

FUTURE ENVIRONMENT

Even if the mining and reclamation plan were not approved and the Hanna South Mine not developed, the future environment of the Hanna area would be modified

due to the continued development of existing coal operations and other resource developments.

The population in those portions of the region that would be impacted by the Hanna South project would increase dramatically even without the project. The population of Carbon County would increase 62% to a total of 29,530 by 1990. Rawlins would increase 90%, Hanna/Elmo would increase 56%, and Saratoga would increase 13%. Employment, income, housing demand, school-age populations, etc., would increase in a like manner through 1990.

Due to the locations of U.S. Highway 30 and State Highway 72, and the close proximity of the town of Hanna, it is anticipated the private lands south of Hanna between the present corporate city limits and U.S. Highway 30 would be developed for housing, mobile home parks, schools, and recreational facilities to accommodate the increased population. The intersection of the highways (Hanna Junction) could be developed for commercial enterprises.

Air and water quality of the area would be lowered slightly. The visual resources of the area would be modified due to development of housing and businesses. Less wildlife would be observed in the area and livestock grazing would be eliminated on a portion of the lands now included in the project area. Noise levels would be higher due to the increased development of the area.

The general recreation uses in the region around the town of Hanna would increase as the population of Carbon County increases. The increase in use would result in a lower quality recreation experience and an increase of access restriction to private lands.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

ASSUMPTIONS AND GUIDELINES

The analysis developed in this chapter is an assessment of impacts resulting from the development of coal on the Hanna South project which would be completed by 1989. Impacts are quantified by time periods of 1980, 1985, and 1990. Quantification may be stated as an increment for the time period or as a cumulative total at the end of each time period. The method that best quantifies the impact will be used.

An analysis of impacts requires establishing assumptions and guidelines for coal-related development. The following narrative and tables were developed to establish such guidelines for the proposed Hanna South project.

Assumptions

Complete data on reclamation success in the southcentral region are not available. Preliminary success, based on observations of seedings on reclaimed areas less than 4 years old, has been minimal and in some cases a total failure. These minimal results are attributed primarily to climatic conditions (low precipitation, low humidity, strong winds, etc.); also to the method of handling overburden, parting material, and topsoil, and to the minimal use of proper seed mixture, contour furrowing, and mulching (reference Regional, Chapter 2, Vegetation).

Based on field observations of other reclaimed areas such as roadside cuts and fills, borrow areas, etc., it is estimated that reclamation would occur as outlined in items 2 and 3 that follow. This would occur, assuming that all mitigating measures proposed in the reclamation plan would be applied. The mitigating measures outlined in the reclamation plan are proposed under the regulations that existed prior to SMCRA. The reclamation success anticipated with the application of SMCRA regulations is discussed in Chapter 4.

Drainage control dams (three) to be constructed on federal lands (Sections 28 and 32) will be retained. The landowners will probably request retention of the drainage control dams to be constructed on private land (Section 30).

Guidelines

1. Impacts are analyzed for three time points (1980, 1985, and 1990).

2. Preliminary reclamation in an area is considered complete when disturbed lands have been backfilled, graded, contoured, and seeded.

Complete reclamation of an area will require an average of 7½ years or more; 3 years for filling, shaping, contouring, seedbed preparation, and seeding; 4½ years or more (up to 10 to 15 years) for establishment of vegetative cover in accordance with the proposed reclamation plan.

3. Reclamation of land as proposed in the reclamation plan would take place in the following sequence and result in a vegetative cover suitable for cattle grazing.

- 1st year—shaping (filling and contouring)
- 2nd year—reshaping, topsoiling, and mulching
- 3rd year—seedbed preparation and seeding (fall)
- 4th year—rest for seedling establishment
- 5th year—rest for plant vigor, and reseeding of failure areas
- 6th year—rest for plant vigor and seedling establishment
- 7th year—rest for plant vigor
- 8th year—defer first half of grazing season

Tables HS3-1 and HS3-2 are presented to provide an overview of total land disturbance that would occur by the development of the Hanna South project. Table HS3-1 portrays the acres of land disturbed and reclaimed during each designated time period by various activities related to the project. Table HS3-2 portrays the disturbance and reclamation of the same acreage as cumulative total for each time period by activities. Table HS3-3 provides a summary of impacts.

AIR QUALITY

Emissions from the Proposed Mine

Mining activities at the proposed Hanna South Mine would generate certain quantities of fugitive dust emissions. As a result, there would likely be a change in the total suspended particulate (TSP) concentration at the mine site and in surrounding areas. In order to determine the magnitude of such changes, it is necessary to identify the sources of fugitive dust emissions at the mine site, quantify the emissions from each source, locate the source within the proposed mining activity, and subsequently interpret the resultant air quality.

Ten major sources of fugitive dust have been identified at the proposed facility: haul road traffic, shovel/truck

Table HS3-1

ACREAGE DISTURBED BY ACTIVITY AND ACREAGE
RECLAIMED OVER PERIOD OF TIME
(NON-CUMULATIVE)

Activity	1980	1985	1990	Total
	Time Periods			
Final Contour	175	427	130	732
Mine Facilities	54	9	---	63
Ancillary Facilities	14	---	---	14
Subtotal	243	436	130	809
Population	75	---	---	75
Total	318	436	130	884
Acres Reclaimed	0	180	312	492*

*The remaining 272 acres of the 764 acres to be reclaimed would be reclaimed after 1990.

Source: BLM 1978

Table HS3-2

ACREAGE DISTURBED BY ACTIVITY AND ACREAGE RECLAIMED OVER PERIOD OF TIME (CUMULATIVE)

Activity	Time Periods 1980	1985	1990
Final Contour	175	602	732
Mine Facilities	54	63	63
Ancillary Facilities	14	14	14
Subtotal	243	679	809
Population	75	75	75
Total	318	754	884
Acreage Reclaimed	0	180	492*

*The remaining 272 acres of the 764 acres to be reclaimed would be reclaimed after 1990.

Source: BLM 1978

Table HS 3-3

SUMMARY OF IMPACTS

Resource and Impact Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Climate	None	N/A
Air Quality		
AQ-1	Generation of fugitive emissions, causing an increase in TSP concentrations at the mine site and closely surrounding areas	No
AQ-2	Reduced visibility	No
AQ-3	Slight amounts of NO_2, SO_2, and HC generated by mine vehicles	No
Geology		
GE-1	Unstable backfilled area unsuitable for development	N/A
Paleontology		
GE-2	Loss of paleonotological resources	N/A
Topography		
TO-1	Alteration of existing features and drainages	Yes - 30 CFR 715.14
Soils		
SO-1	Destruction of established soil Profiles on 809 acres	N/A
SO-2	Loss of soil productivity on 809 acres	Yes - 30 CFR 715.16
SO-3	Increased soil loss by wind (0.42 ton/acre-year) and water (2.5-5.0 ton/acre-year) erosion on unprotected acres (809 acres)	Yes - 30 CFR 715.13 30 CFR 715.14 30 CFR 715.16 30 CFR 715.20
SO-4	Fugitive dust (soil loss) from mining activities	N/A
SO-5	Increased wind and water erosion (see above) on topsoil stockpiles and overburden spoil piles	Yes - 30 CFR 715.14 30 CFR 715.16(c) 30 CFR 715.16(a)
SO-6	Contamination of soil around mine facilities	Yes - 30 CFR 715.14(j)
SO-7	Alteration of topography, slopes, and drainage patterns, resulting in increased erosion	Yes - 30 CFR 715.14 30 CFR 715.14(i)
SO-8	Exposure of material toxic to revegetation (See Table HS 3-7)	Yes - 30 CFR 715.14(j)
SO-9	Permanent utilization of soil resource for an alternate use	Unknown - 30 CFR 715.18(b)

Table HS 3-3
(Continued)

SUMMARY OF IMPACTS

Resource and Impact Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Water Resources		
WR-1	Lowered water level in a well near the mine	Yes - 30 CFR 715.17(i)
WR-2	Destruction of two stock reservoirs	Yes - 30 CFR 715.17(i)
WR-3	Increased water use	N/A
Vegetation		
VG-1	Loss of vegetative cover on 809 acres for a 10 year period	N/A
VG-2	Reclamation would result in conversion of vegetative type for long term (40 to 50 years)	Yes - 30 CFR 715.13(a) 30 CFR 715.20(a)
VG-3	Grazing of young plants on reclaimed areas would delay establishment of vegetative cover during a 40 to 50 year period	Yes - 30 CFR 715.13(a) 30 CFR 715.20(a)
VG-4	Control of haul road dust and fugitive coal dust that could reduce palatability of effected vegetation for 10 years would be 50% effective	N/A
VG-5	Noxious weeds could invade onto the disturbed and reclaimed areas	N/A
VG-6	Loss of native vegetative cover on 75 acres utilized in housing and support service sites	N/A
VG-7	Vegetative productivity level on reclaimed lands is expected to be 495 pounds air dry vegetation per acre as compared to 660 pounds on premined acreage	Yes - 30 CFR 715.13(a) Yes - 30 CFR 715.20(a)
Fish and Wildlife		
WL-1	Direct loss of 809 acres of wildlife habitat for 40 to 50 years	Yes - 30 CFR 715.13(a)
WL-1a	Loss of an unquantifiable number of small nongame birds on 809 acres	
WL-1b	Loss of 86 sage grouse on 749 acres	
WL-1c	Loss of an unquantifiable number of small nongame rodents on 809 acres	
WL-1d	Loss of an unquantifiable number of cottontail rabbits on 809 acres	
WL-1e	Loss of an unquantifiable number of reptiles on 809 acres	

Table HS 3-3
(Continued)

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Fish and Wildlife (continued)		
WL-2	Destruction of four drainage control dams (built as a result of mining operations) would reduce wildlife habitat	N/A
Cultural Resources		
CR-1	Possible destruction of subsurface archeological sites	N/A
Visual Resources		
VR-1	Destruction of existing landscape	N/A
Recreation Resources		
RE-1	Loss of recreation visitor days - especially hunting	N/A
Agriculture		
AG-1	Loss of suitability of range for sheep grazing on 809 acres for 40 to 50 years	Yes - 30 CFR 715.13(a) 30 CFR 715.20(a)
AG-1a	Loss of 13,061 animal unit months of grazing during mining and reclamation	
AG-2	Destruction of one stockwater reservoir	Yes - 30 CFR 715.17(e) 30 CFR 715.17(k)
Mineral Resources		
MR-1	Loss of mineral resources (coal, sand, gravel, scoria) through mining and mine-related uses	N/A
Land Use Plans		
LU-1	Surface mining within a zoned scenic corridor	N/A
Socioeconomics		
SE-1	Regional population increase of 381 by 1990	N/A
SE-2	Employment increase of 174 by 1990	N/A
SE-3	Total earning increase of $6.9 million by 1990	N/A

Table HS 3-3
(Continued)

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Socioeconomics (continued)		
SE-4	Additional housing demand of 225 units (192 single family) by 1990	N/A
SE-5	School District #1 school-age population increase of 68 students School District #2 school-age population increase of 46 students	N/A
SE-6	Worsened population per health care specialist rations	N/A
SE-7	$2.9 million increase in retail and wholesale sales	N/A
SE-8	Increase pressures on local services (water, sewer, police, fire, solid waste)	N/A
SE-9	Increased congestion from coal truck crossing on U.S. 30 and S.H. 72	N/A
SE-10	Increased congestion on access roads especially during shift changes	N/A
SE-11	Eight minutes of additional traffic delay at railroad crossings per week	N/A
SE-12	Increased air and noise pollution	N/A
SE-13	Increased work-related injuries or illnesses by 5.2 cases per year	N/A
SE-14	Increased work-related fatalities or debilitating injuries (not quantifiable)	N/A

loading, blasting, drilling, truck dump, topsoil removal, front-end loading, access road traffic, wind erosion from exposed areas, and stockpile wind erosion. Two point sources identified were coal crushing and train loading. Table HS3-4 lists these emission sources and the corresponding emission factors. The annual emissions from the proposed site were calculated using the emission factors listed in the table. The operational parameters were obtained from the mining and reclamation plan, Chapter 1 of the environmental statement, and personal communications with the Bureau of Land Management.

Emission inventories were performed for the mining years of 1980, 1985, and 1988 which is the last active year of mining. These inventories are the best approximations of the complex interaction of variables. Table HS3-5 presents the annual emissions from each source for the designated years.

Best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the Cherokee mining and reclamation plan on file with GS in December 1977 were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

The gaseous air pollution sources would be exhaust emissions from diesel-powered haul trucks and employees' motor vehicles. Emission factors for vehicular travel were obtained from EPA's most recent compilation of mobile source emission factors and reflect current legislation relative to future emission standards in high altitude areas (EPA 1978).

Estimated emissions of carbon monoxide (CO), hyrodcarbons (HC), oxides of nitrogen (NO_x), and sulfur oxides (SO_x) are shown in Table HS3-5A. These emissions are both from employee travel on the mine site and haul trucks.

Impact on Air Quality

The impact of the above annual emissions on the nearby ambient TSP concentrations was determined by the use of the Modified Climatalogical Dispersion Model-Version 3 (MCDM-V3) (PEDCo Environmental, Inc. 1976). The model performs both annual averaging and worst case 24 hour periods. Data input consists of area sources from the mining area and point sources where applicable.

MCDM determines long and short-term quasi-stable pollutant concentrations at any ground-level receptor using average emission rates from point and area sources and a joint frequency distribution of wind direction, wind speed, and stability for the same period. Climatological input data is in the form of a Stability Rose (STAR) deck. The STAR deck used for modeling the proposed action was generated from data collected at the Rawlins, Wyoming weather station. Also included in the program was a particulate fallout function to simulate the deposition of the large suspended particulates as they disperse downwind. The fallout rates incorporated in the model were based on sampling data from several western coal rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particulate size. An explanation of these factors and their development is described by PEDCo Environmental, Inc. 1978.

Maps HS3-1 through HS3-3 show the annual predicted and resulting ambient TSP concentrations for the years 1980, 1985, and 1988, as determined by the model. Maps HS3-4 through HS3-6 show the worst case 24-hour predicted and resulting ambient TSP concentrations for the same study years. Concentrations in both situations are shown to decrease rapidly with distance.

Maps HS3-1 and HS3-2 for the years 1980 and 1985 show annual TSP concentrations approaching or exceeding the Wyoming particulate standard at a distance of 1.2 miles to the north and 1.8 miles to the east of the mine border. The applicable standard for the area is 60 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean. Since the town of Hanna is only 1 mile north of the mine, the fugitive dust emissions would have a detrimental impact on Hanna's air quality. Maps HS3-4 and HS3-5, depicting worst case 24-hour averages, indicate violations of the 24-hour standard of 150 $\mu g/m^3$ at a distance of 1.2 miles east and 0.3 miles north of the mine border.

Note that under the new PSD regulations (43 CFR 118), these violations do not occur. In fact, the surface mines are well within the applicable NAAQS and PSD regulations.

The year 1988 is to be the final year of coal production at the Hanna South Mine. Maps HS3-3 and HS3-6 graphically display predicted TSP concentrations for that year. Violations of the annual standard are predicted at a distance of 0.7 to 1.1 miles north and northeast of the mine. The model also predicts violations of the 24-hour standard at a distance of 0.6 miles north of the mine site.

Again, with the application of the 43 CFR 118 regulations, the violations of the Class II increment would not occur.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed facility. Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants carbon monoxide (CO), hydrocarbons (HC), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Predicted concentrations of these pollutants were not modeled due to the lack of detailed data on vehicle use and applicable background data. However, recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines estimate the probable range of impact to be insignificant. Assuming similar vehicle activity for the proposed mine, ambient concentrations of gaseous pollutants would be minimal and insignificant compared to their respective standards.

Table HS3-4

FUGITIVE AND POINT SOURCES IDENTIFIED AT THE PROPOSED FACILITY WITH CORRESPONDING EMISSION FACTORS*

Emission Source	Emission Factor
Fugitive:	
1. Haul Roads	
a. Coal	
1) Unpaved	6.8 lb/vehicle-mile traveled
2) Paved	0.01 lb/vehicle-mile traveled
b. Overburden	13.6 lb/vehicle-mile traveled
2. Shovel/Truck Loading	0.037 lb/ton loaded
3. Blasting	
a. Coal	72.4 lb/blast
b. Overburden	85.3 lb/blast
4. Truck Dumping	
a. Coal	0.020 lb/ton
b. Overburden	0.002 lb/ton
5. Drilling	
a. Coal	0.22 lb/hole drilled
b. Overburden	1.5 lb/hole drilled
6. Topsoil Removal	
a. Scraping	0.35 lb/yd^3 scraped
b. Dumping	0.03 lb/yd^3 dumped
7. Front-End Loading	0.12 lb/ton loaded
8. Access Road Traffic	5.11 lb/vehicle-mile traveled**
9. Exposed Areas (wind erosion)	0.42 tons/acre-year***
10. Coal Storage	8.64 lb/acre-hr
Point Sources:	
1. Coal Crushing	0.01 lb/ton
2. Train Loading	0.0002 lb/acre-hr

*Emission factors from PEDCo Environmental, Inc. 1978, except as noted.

**Calculated from formula in U.S. Environmental Protection Agency, 1975.

***Calculated from formula in Midwest Research Institute, 1974.

Table HS3-5

ANNUAL EMISSIONS FROM EACH MAJOR SOURCE FOR EACH STUDY YEAR

Emission source	Tons per year		
	1980	1985	1988*
1. Haul Roads (with watering)	1,029	929	543
2. Shovel/Truck Loading	120	120	120
3. Blasting	18	18	17
4. Truck Dumping	11	11	10
5. Drilling	3	2	2
6. Topsoil Removal	42	42	0
7. Front-End Loading	31	31	22
8. Access Roads	20	3	3
9. Exposed Areas (wind erosion)	94	83	64
10. Train Loading	<1	<1	<1
11. Crushing	<1	<1	<1
12. Storage	7	7	7
Total	1,375	1,263	805

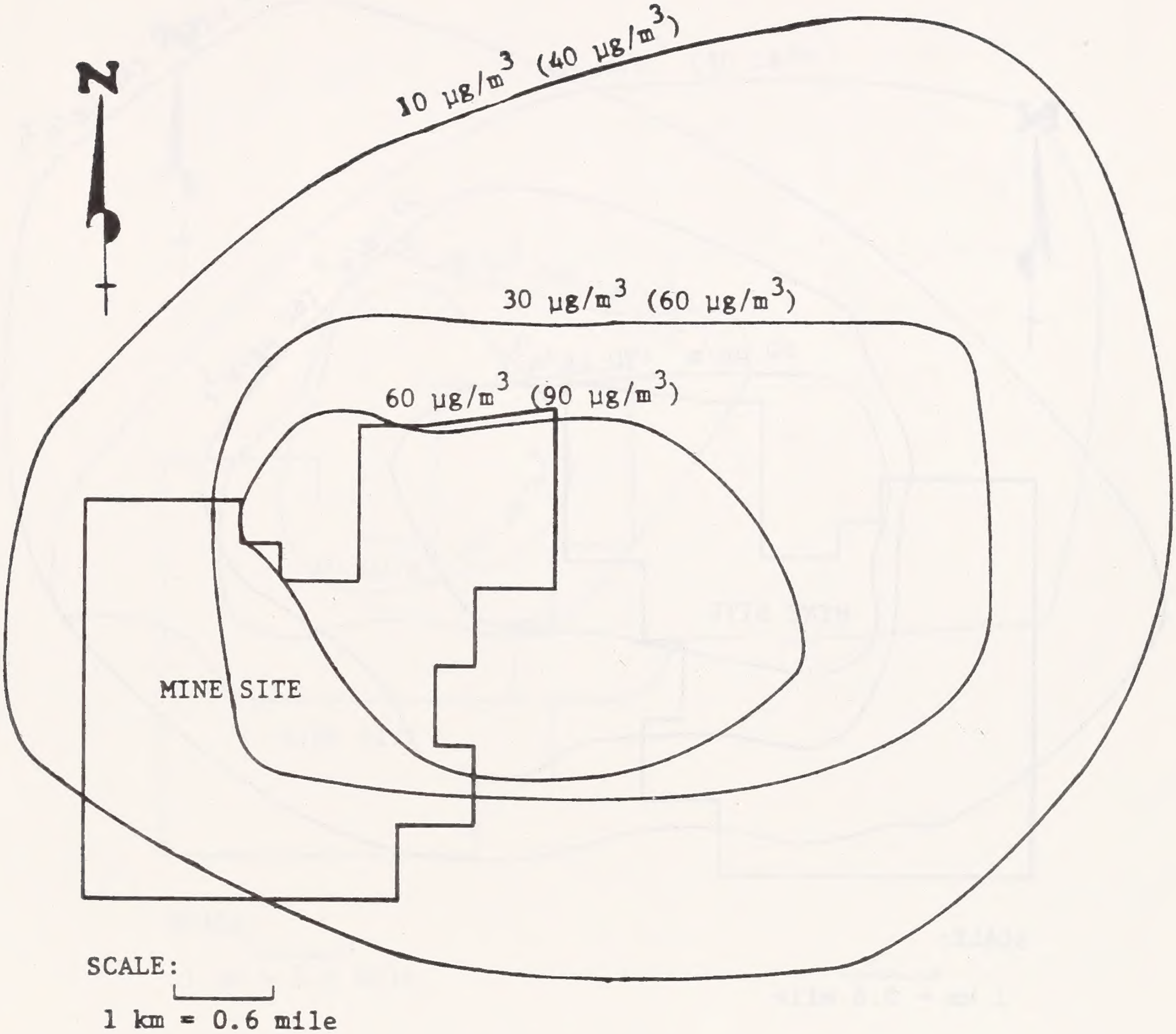
* Last active year of mining.

Table HS3-5a

EMISSIONS OF GASEOUS POLLUTANTS FROM VEHICLES AT THE

PROPOSED HANNA SOUTH MINE SITE

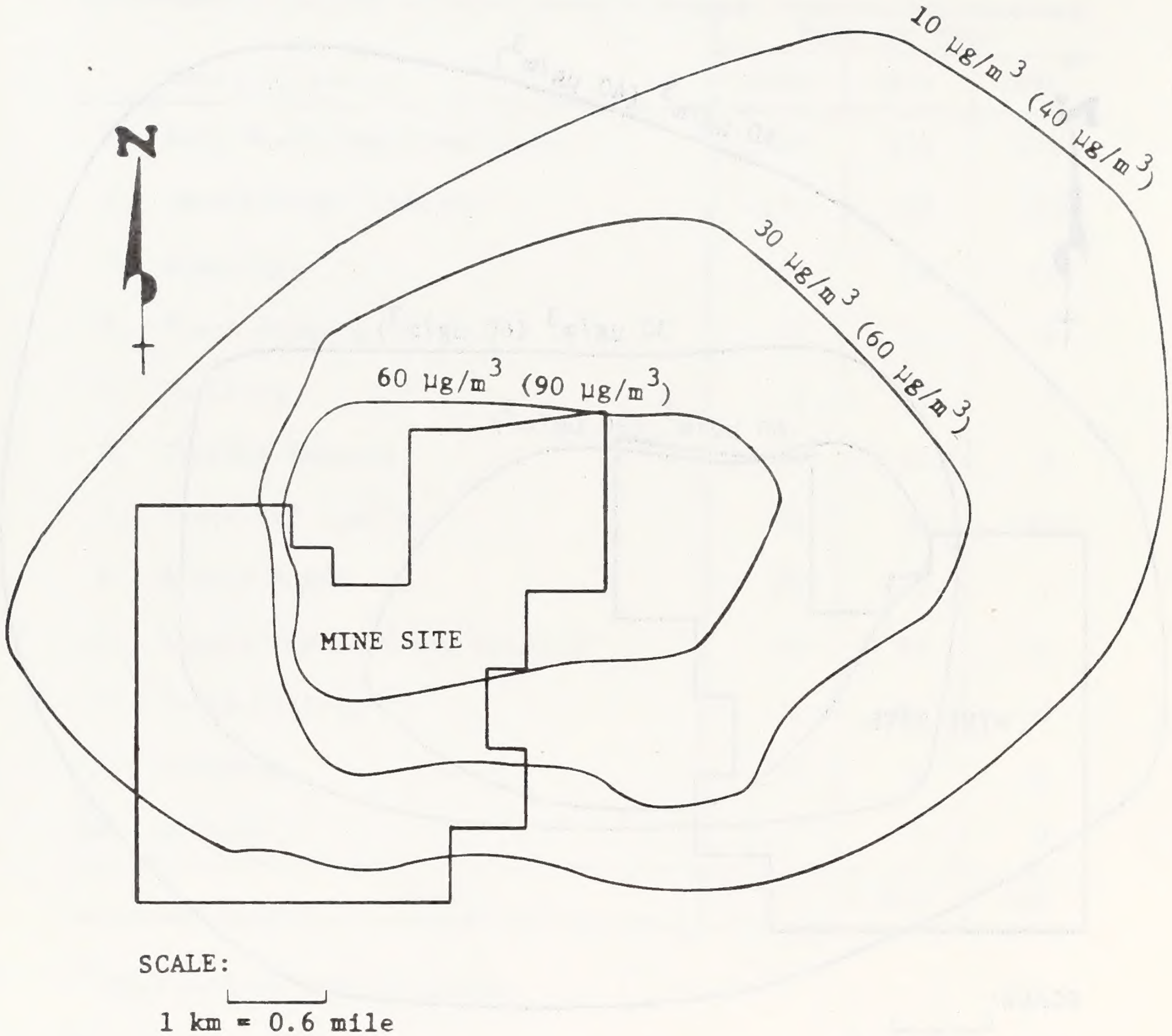
Year	Total emissions, ton/yr			
	CO	HC	NO_x	SO_x
1980	6.7	1.0	2.7	0.7
1985	5.7	0.5	2.3	0.6
1988	3.8	0.4	1.6	0.4



MAP HS3-1

ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1980 AT THE PROPOSED HANNA SOUTH MINE SITE.*

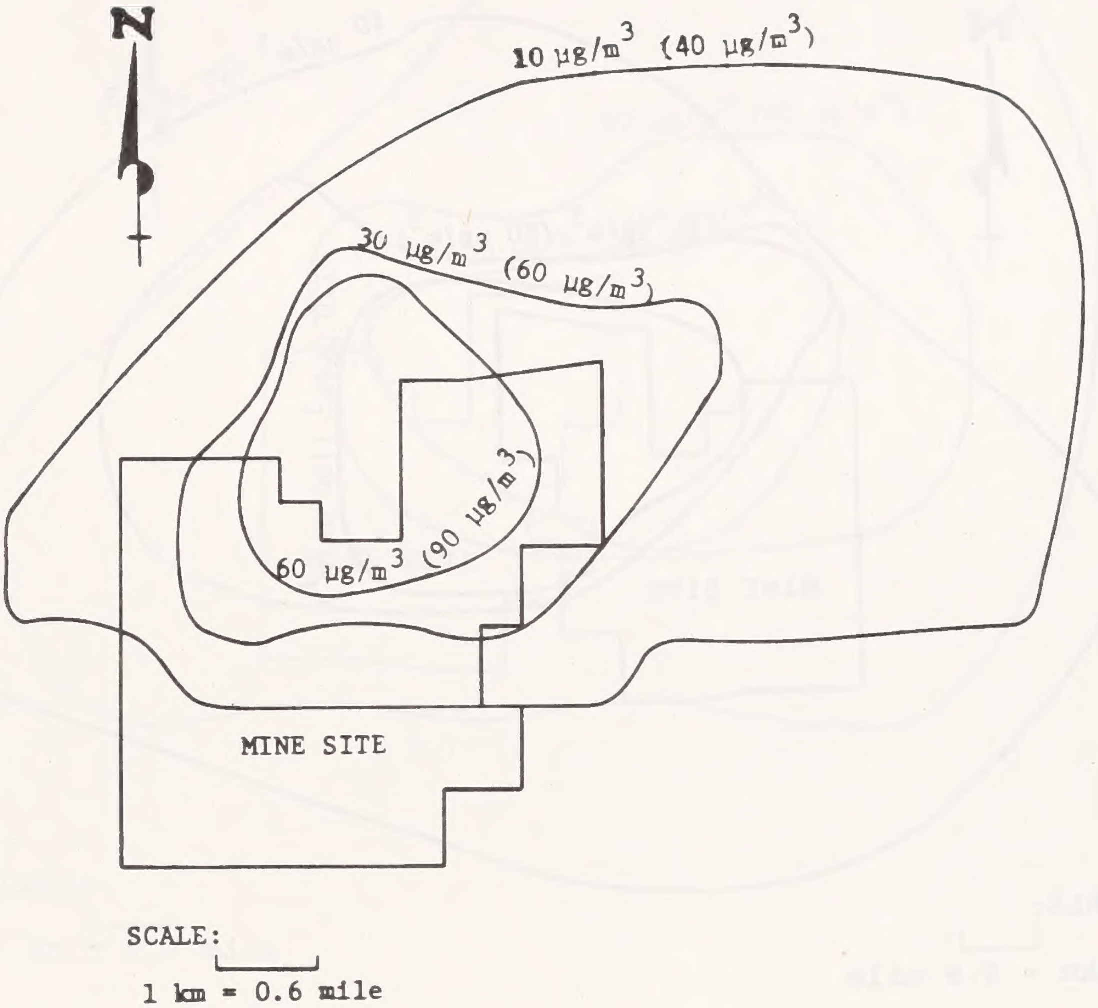
*Resulting ambient concentration is in parentheses.



MAP HS3-2

ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1985 AT THE PROPOSED HANNA SOUTH MINE SITE.*

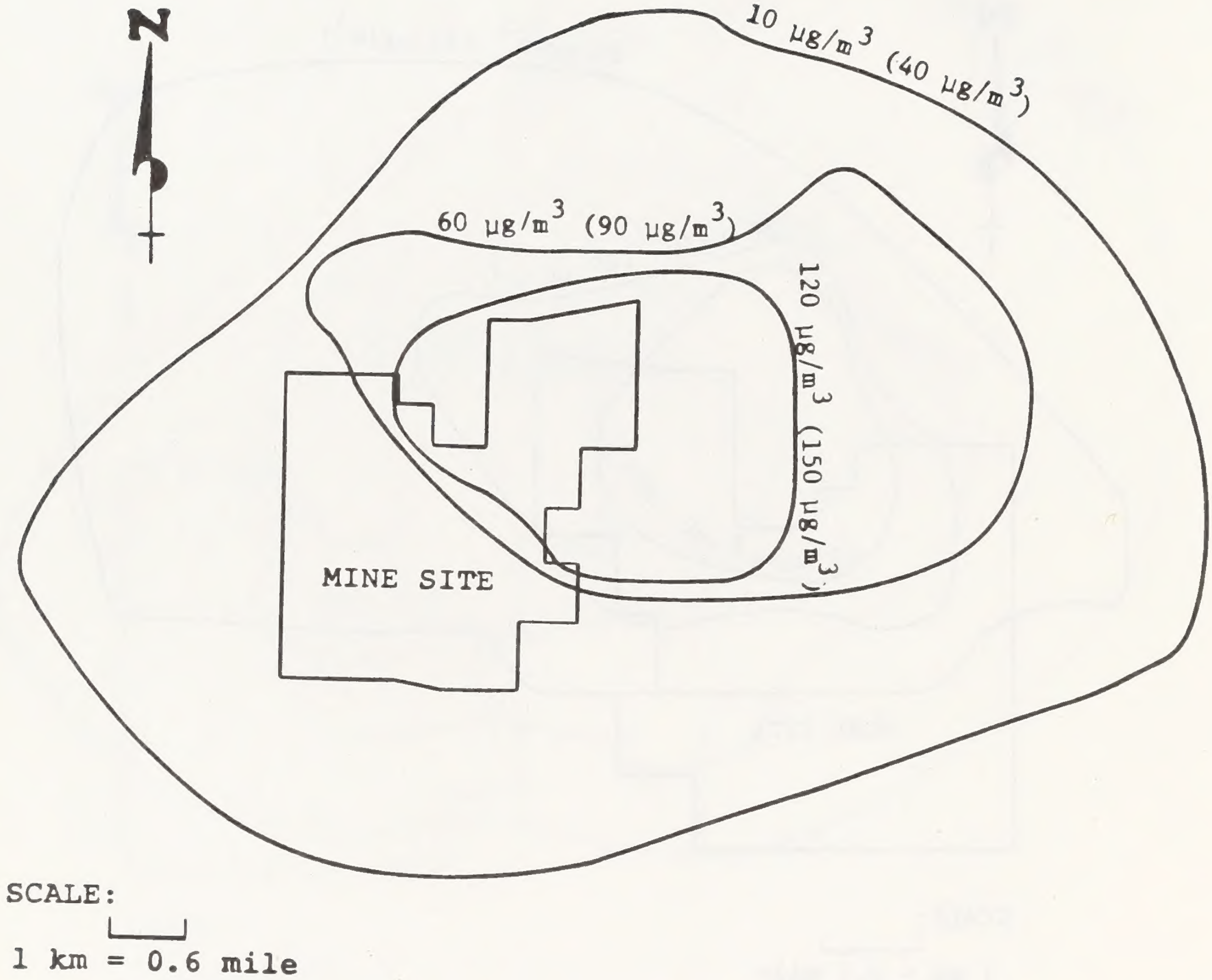
*Resulting ambient concentration is in parentheses.



MAP HS3-3

ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1988 AT THE PROPOSED HANNA SOUTH MINE SITE.*

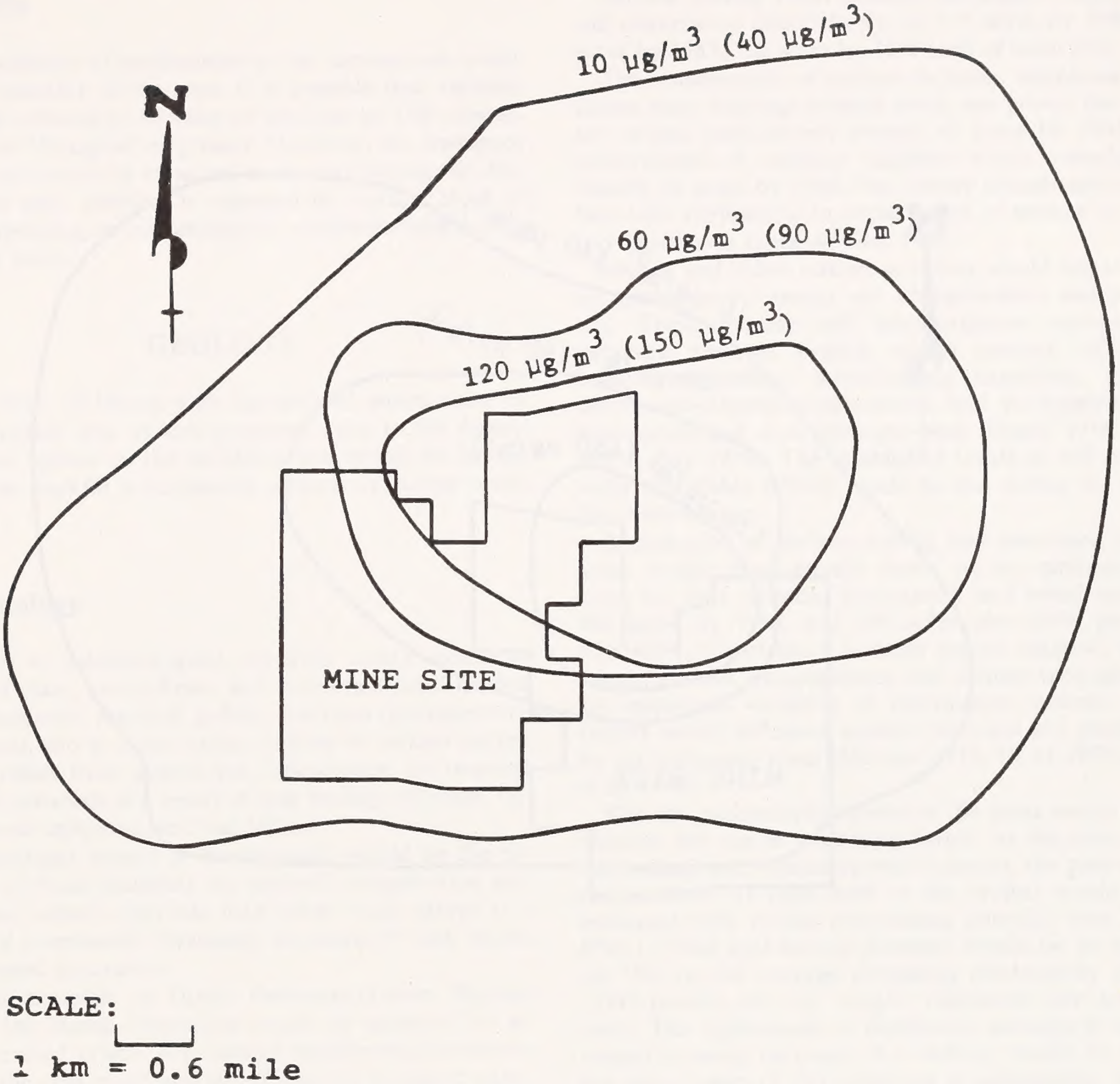
*Resulting ambient concentration is in parentheses.



MAP HS3-4

ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1980 AT THE PROPOSED HANNA SOUTH MINE SITE.*

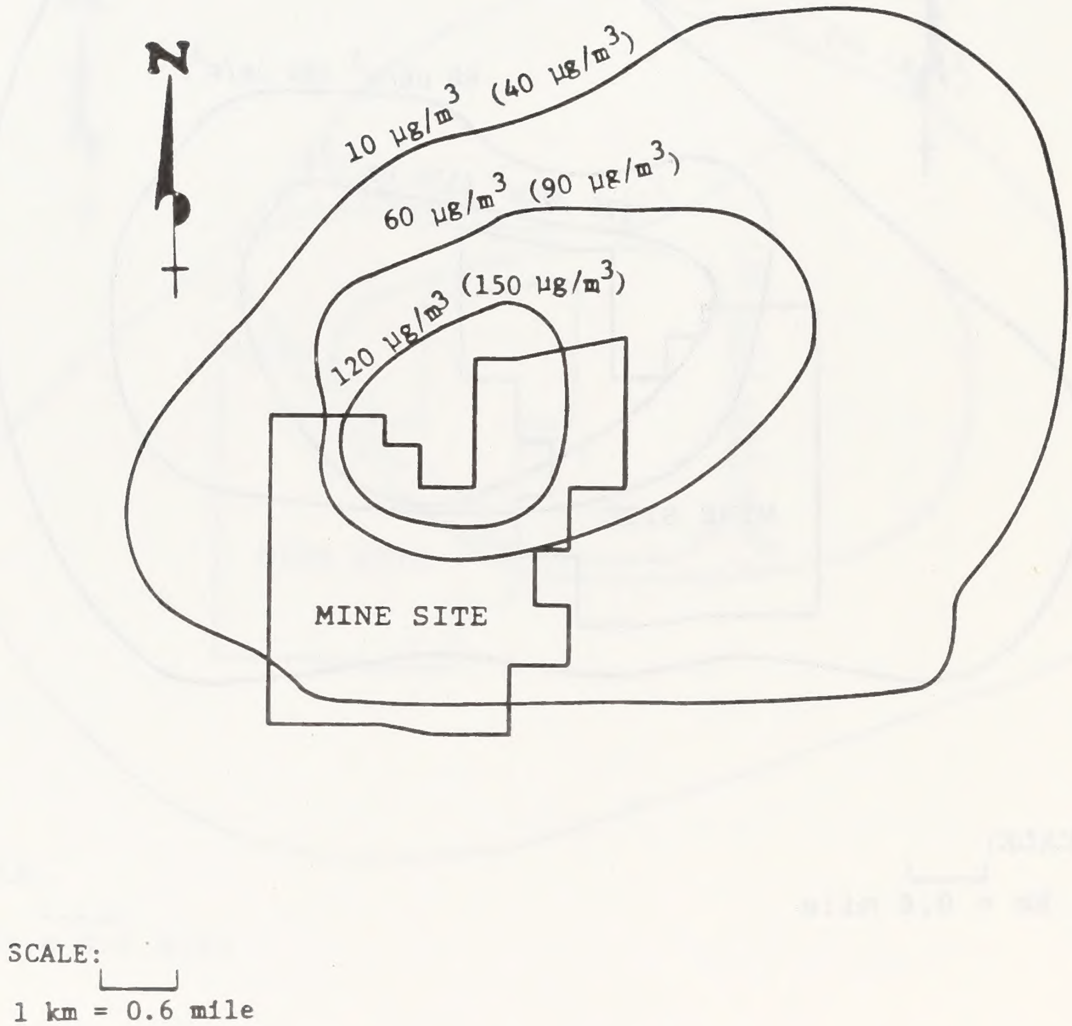
*Resulting ambient concentration is in parentheses.



MAP HS3-5

ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1985 AT THE PROPOSED HANNA SOUTH MINE SITE.*

*Resulting ambient concentration is in parentheses.



MAP HS3-6

ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1988 AT THE PROPOSED HANNA SOUTH MINE SITE.*

*Resulting ambient concentration is in parentheses.

Visibility

The addition of particulates to the atmosphere would reduce visibility in the area. It is possible that visibility could be reduced to 10 miles or less, due to TSP concentration of 150 $\mu g/m^3$ or greater. However, the frequency of this occurrence is expected to be very infrequent. For the most part, visibility is expected to average 26 to 47 miles depending on climatological conditions such as fog, rain and snow.

GEOLOGY

The town of Hanna may expand and annex some of the backfilled area of this proposed mine in the future. Land use options on the backfilled area would be limited unless the backfill is compacted adequately during reclamation.

Paleontology

Impact to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses of various degree would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

Fossil materials of Upper Paleocene/Lower Eocene age in the Hanna Formation would be impacted to an undetermined extent. All exposed fossilferous formations within the area could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased regional population. The extent of this impact cannot presently be assessed due to a general lack of specific data on such activities.

TOPOGRAPHY

The proposed action would result in an active strip mine for 10 years (1979 to 1988). The stripping operation would create temporary steep, unnatural slopes where gentle slopes existed before. A fairly significant drainage (Standpipe Draw) would be altered along about 2 miles of its course. A tributary to Big Ditch would be altered along ½ mile of its course. Haul roads would require cuts and fills that would alter the present topography.

SOILS

Surface mining (final contour acreages) would cause soil disturbance cumulatively on 175 acres by 1980; 602 acres by 1985; 732 acres by 1988 (end of mine life).

The construction of surface facilities, telephone lines, access road, drainage control dams, and power line (34.5-kv) would cumulatively disturb 63 acres by 1985. The construction of ancillary facilities would cumulatively disturb 14 acres by 1980. No further disturbance of surface soils attributable to construction of surface or ancillary facilities is expected after 1985.

Mining and other related activities would impact soils by alteration of existing soil characteristics and properties. These include soil microorganism composition, structure, textures, organic matter content, infiltration rates, permeability, waterholding capacities, nutrient levels, soil-climatic relationships, and productivity that have developed over geologic time (Brady 1974; BLM 1975a; Bay 1976). The established levels of soil productivity (see Table HS3-6) would be lost during the period from disturbance.

Reclamation of surface mining and associated facility areas would cumulatively occur on an estimated 180 acres by 1985 (seedbed preparation and initial seeding); 492 acres by 1990; and 764 acres after 1990 (refer to Chapter 3, Vegetation). Suitable topsoil material, slopes, aspect, surface manipulations, and climate (precipitation) are important variables of reclamation success. These factors would influence erosion rates and soil productivity on reclaimed areas (Monsen 1975; BLM 1975a; May et al. 1971).

The soil productivity levels on 764 acres would be reclaimed, but not to premining levels. At the time of initial seeding and vegetative establishment, the post-mining soil productivity over most of the project would be an estimated 50% of the post-mining potential (see Figure HS3-1). This post-mining potential would be an estimated 75% of the average premining productivity (400 to 1,000 pounds air dry weight vegetation per acre per year). The replacement of insufficient amounts of suitable topsoil material (average of 6 inches) would be one of the main causes of this reduction in post-mining productivity levels. The productivity levels would increase during the 40 to 50 years after the start of reclamation. As this occurs potential soils productivity levels which are approximately 75% of the premining productivity levels would be attained due to proper management and increased microbial interactions. Physical and chemical changes in these new soils would also be initiated.

The lack of suitable soil material, moderately steep to steep slopes, and areas poor for reclamation are evident on the Hanna South project area in mapping units 252 and 254 (refer to Chapter 2, Soils Section). The disturbance of these soils (in 252 and 254) would lead to an improvement in soil productivity on approximately 197 acres, since soils depths, slopes, and subsoil alkalinity (254) would be altered.

Mining would involve the excavation and storage of topsoil (44 acres) and the storage (244 acres) of usable and unusable overburden material. Increased erosion would occur on stockpiled materials. Mining activities would also increase soil loss from increased fugitive dust

Table HS3-6

SOIL PRODUCTIVITY & ACRES DISTURBED

Mapping Unit*	Soil Association**	Acres Disturbed***	Volume of Soil****	Soil Productivity*****
210	Ravalli (30%)-Forelle (30%) #15 (25%)	112	301,000 - 903,000	475 - 735
251	Grieves (55%)-Blackhall (30%)	--	--	595 - 930
252	Shinbara (35%)-Blazon (30%) Rock Outcrop (25%)	49	0 - 40,000	238 - 374
253	Blazon (40%)-Satanka (35%)	353	285,000 -1,281,000	410 - 685
254	Bullock (45%)-Blazon (35%)	148	119,000 - 198,000	464 - 514
257	Havre-Glendive (85%)	8	32,000 - 65,000	1360 - 1955
258	Rock River (45%)-Satanka (35%)	62	125,000 - 500,000	525 - 925
260	Ryan Park (45%) Rock River (30%)	--	--	525 - 900

*Map reference numbers refer to Soils Map HS

**Soil series and percent making up soil associations: minor soils comprising a part of a soil association are not listed in this table; therefore, the composition does not total 100% for each soil association.

***Acres disturbed by soil association in final contour acreage.

****Amounts of topsoil material available for reclamation in cubic yards, based upon final contour acreage disturbed and inches available for use in soil associations.

*****Soil productivity of soil associations (pounds air dry weight vegetative productions per acres per year--SCS production data). Additional minor soils in each association not included in calculations.

Sources: U.S. Department of Agriculture, 1978, and MRC 1976e, MRC 1976f

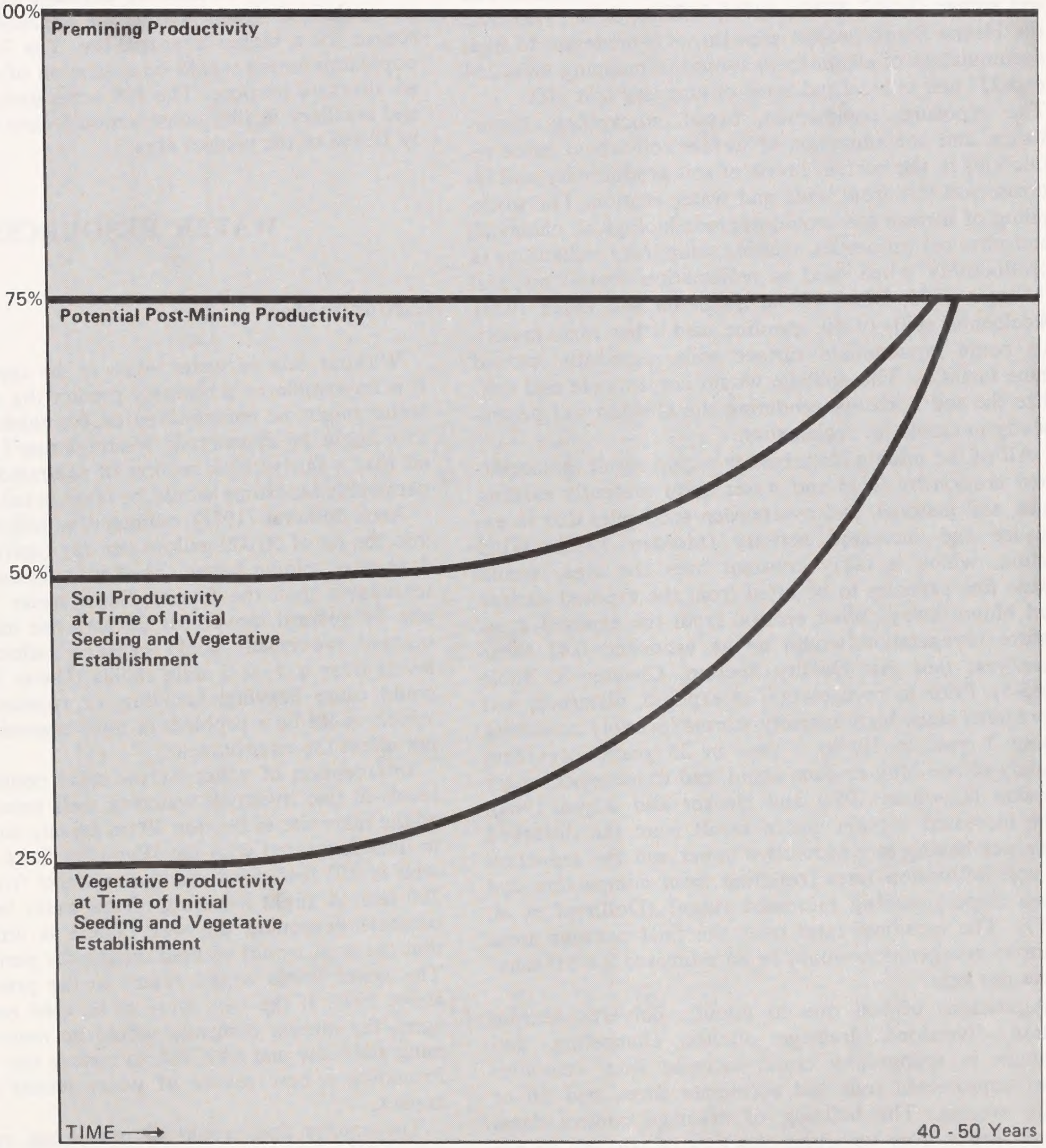


Figure HS 3-1

SOIL AND VEGETATIVE PRODUCTIVITY UNDER THE PROPOSED ACTION
Hanna South

levels, especially haul road dust (see Air Quality Section, Chapter 3, Table HS3-4).

Mining would expose materials in the area that could hamper reclamation. These could include overburden and parting material with high alkalinity (SAR) or salinity (E.C.); low or high pH; sand or clay textured material; and material with low cation exchange capacities (see Table HS3-7). The overburden analyses of test holes OB 16, 3136, and 3042 show extensive amounts of overburden and parting material unsuitable for reclamation use (see Map HS1-4). Additional material in test holes OB 3116, 3215, 3605, 3109, and 3435 is also unsuitable. The soil survey (MRC 1976e, 1976f; USDA, SCS 1978) over the Hanna South project area shows a moderate to high accumulation of alkalinity in subsoil in mapping units 254 and 257 and in localized areas of mapping unit 210.

The exposure, compaction, burial, stockpiling, disturbance, and contamination of surface soil would cause reductions in the current levels of soil productivity and increase soil loss from wind and water erosion. The stockpiling of surface soil would degrade biological, chemical, and physical properties, causing temporary reductions in productivity when used as reclamation topsoil material (Monsen 1975; BLM 1975a; Singleton and Cline 1976). Accidental spills of oil, gasoline, and other toxic materials could contaminate surface soils, especially around mine facilities. This spillage would contaminate and sterilize the soil horizons, rendering the affected soil permanently unusable for reclamation.

All of the mining disturbances would result in accelerated erosion by wind and water upon presently existing soils, soil material, and overburden spoil piles due to exposure and increased activity (Monsen 1975). Wind action, which is fairly constant over the area, would cause fine particles to be lifted from the exposed surface and blown away. Wind erosion from the exposed areas before revegetation would be an estimated 0.42 tons/acre/year (see Air Quality Section, Chapter 3, Table HS3-5). Prior to revegetation of exposed, disturbed, and stockpiled soils, high intensity storms (possibly occurring about 1 year in 10, to 1 year in 25 years) occurring mainly in late May or June could lead to increased water erosion (Lowham 1976; and Becker and Alyea 1964). The increased erosion would result from the disturbed soils not having any protective cover and the reduction of soil infiltration rates (resulting from compaction and steep slopes) causing increased runoff (Dollhopf et al. 1977). The erosional rates over the final contour areas prior to revegetation would be an estimated 2.4-5.0 tons/acres per year.

Alterations of soil due to mining, culverts, settling ponds, diversions, drainage ditches, channeling, and changes in topography could increase flow velocities from unprotected soils and accelerate sheet, and rill or gully erosion. The building of drainage control dams would lower flow velocities. An area of concern would be Standpipe Draw where mining and construction would involve exposure and disturbance of drainage channels (mapping unit 210) (see Water Resources, Chapter 3).

Mine-related population increases and their associated housing and community support facilities would cumulatively remove 75 acres from productivity by 1980. Additional loss is not anticipated after 1980 (refer to Table HS3-3 in Assumptions and Guidelines).

All developments (surface mining, mine facilities and access roads, power line, telephone line, and mine associated increased population needs) would cumulatively disturb soils on 318 acres by 1980; 754 acres by 1985; 884 acres by 1990 (mining would be completed in 1989; reclamation would be occurring in 1990).

The 45 acres covered by drainage control dams and not reclaimed would involve the utilization of the soil resource for a higher alternate use. The 75 acres used for population needs would be utilization of soil resource for an alternate purpose. The 809 acres disturbed by mining and ancillary facility construction would be approximately 19.6% of the project area.

WATER RESOURCES

Groundwater

Without data on water levels in the areas to be mined, it is impossible to accurately predict the depth at which water might be encountered or the thickness of aquifer that might be dewatered. Westinghouse (1976d) estimated that a fairly thick section of saturated, but not very permeable sandstone would be intercepted.

Arch Mineral (1977) estimated a maximum discharge into the pit of 50,000 gallons per day (gpd) occurring 400 days after mining began. The latter figure appears more reasonable than the former. Some water may enter the pits by upward movement through the mine floor. This upward movement could cause a reduction in water levels over a 1 or 2 mile radius (Davis 1976b). It also could cause heaving, buckling, or rupture of the floor, which could be a problem in mine operation, but would not affect the environment.

Interception of water by the mine could affect water levels in one livestock watering well immediately north of the mine site in Section 19 on private land. According to data registered with the Wyoming State Engineer, the well is 250 feet deep and draws water from a depth of 200 feet. A slight lowering of the water level could necessitate deepening the well. There is little probability that the well would be used during the period of mining. The water levels would return to the present levels by about 1996. If the well were to be used and were damaged, the mining company would be required by Wyoming state law and SMCRA to restore the water supply. Providing a new source of water would eliminate the impact.

The aquifer that would be mined has extremely low permeability; therefore, little probability exists that a significant quantity of water can flow from the mine pit to the downgradient wells.

Mine drainage would be pumped from the pits and allowed to follow natural drainages within the mine prop-

Table HS3-7

OVERBURDEN ANALYSIS FOR SUITABILITY AS SOIL MATERIAL

Test Hole	Depth of Levels (Feet)	Limiting Factors*
16	0-84	E.C. & SAR
3136	60-136	E.C. & SAR
3116	0-20	E.C. & SAR
3215	0-23	E.C. & SAR
3605	0-11	E.C.
3042	0-40	E.C.
3109	0-19	E.C.
3435	24-34	Low pH

*Limiting factors: low pH--acidic material; E.C.--salinity; SAR--alkalinity and/or salinity

erty to settling ponds that would be operated under permits from, and requirements of, 30 CFR 211 and 715 and the state of Wyoming DEQ and State Engineer. The ponds would probably be of the dugout type; thus the hazard of highly mineralized sediment being released during a pond failure would be eliminated. Water from the ponds would be used for dust control. There is little probability that water would be released off the property, but if any were released, it would meet Wyoming DEQ standards.

Surface Water

The company proposes to construct four flood control dams to reduce flow into the mine pits that cross watercourses. The dams would be designed to contain the runoff from a 100 year/6 hour storm and would have spillways to carry any greater flow into the mine pits. Flood control structure of this type are not governed by SMCRA, but the intent of the act as given in sections on dams storing waste could be considered to apply. The design of the dams to hold the 100 year/6 hour storm would be adequate to meet this intent. Failure of the dam would not endanger life nor would it impact any off-site property. No downstream surface water rights would be impaired by impounding runoff behind the flood control dams.

Peak discharges used by the company in design of these dams were obtained by using the Soil Conservation Service method, which tends to give lower peak discharges than those obtained from stream flow records collected on Standpipe Draw (see Table HS2-2). Using too low a discharge estimate could increase the potential for failure. The design volumes are considered satisfactory.

One stock reservoir would be destroyed or rendered useless during mining operations, but the loss of this water supply would be offset by the water stored in four flood control reservoirs and two settling basins. Five other reservoirs just outside the mine boundary would probably not be affected.

Quality

Mine operations would have little impact on quality of groundwater, because little or no water would reach the aquifer from the mine pit or spoils, and the water already contains enough dissolved solids to make it unsuitable for most uses. If the mine adhered to EPA and Wyoming DEQ requirements, as it has agreed to do in its mine plan, surface water that might leave the property would contain less sediment and dissolved solids than the water that now drains off the property. There is almost no potential for acid drainage or overland movement of sediment. This is explained in more detail in the Regional Analysis.

Water Use

The mine would require an average of 3,600 gallons per day (gpd) of potable water for sanitary facilities; 15,000 gpd for cleaning equipment; and 96,000 gpd during summer months for dust control. A 100,000 gallon supply would be maintained for fire protection. Estimated total usage during the year would be 80 acre feet (ac ft). If water was short, the company would reduce the amount used for dust control by watering less frequently or by using chemical dust suppressants.

Wells to be drilled within the project area would provide sanitary and cleaning water and would supplement pit drainage for dust control.

The population increase resulting from the mine would require 20 ac ft/yr. The mine would increase the regional municipal and industrial use by 0.4%.

There is a possibility that dust from the mining operation could settle on the two open reservoirs of the Hanna water supply, (see Map HS2-2) but the prevailing wind direction is away from the reservoirs; therefore dust is not considered to be a major problem. Mining and blasting would not be done closer than about 1,500 feet from the Hanna water supply aqueduct. This would be well beyond the 500 foot limit established by SMCRA. No impact is anticipated.

VEGETATION

Terrestrial

The disturbance of the vegetative resource on the Hanna South project area would begin in 1979 with the construction of mine facilities and initial mining operations. From the start, vegetative disturbance would be continuous until the completion of mining operations in 1988. The acreage of vegetation that would be disturbed by the project is shown in Table HS3-1 and HS3-2 (in Assumptions and Guidelines). The acreage of each vegetative type that would be disturbed by the mine development is shown in Table HS3-8 by time period and in noncumulative and cumulative acreage.

The construction of the mine and ancillary facilities would cause disturbance of 77 acres of vegetation. This acreage would be out of production for the life of the mine.

Mining would begin in 1979; full production would be attained in 1980, the cumulative acreage that would be disturbed by mining construction of haul roads, and storage areas for overburden and topsoil would be 175 acres by 1980; 602 acres by 1985; and 732 acres by 1988 when mining operations would be completed.

Population increase associated with the development of the project would result in the destruction of 75 acres of vegetation by 1980. The town of Hanna is expected to receive practically all of this population growth due to its close proximity to the mining project. The acreage

Table HS3-8

NONCUMULATIVE AND CUMULATIVE ACREAGE OF VEGETATIVE TYPES DISTURBED BY VARIOUS FACILITIES OR ACTIVITIES BY TIME PERIODS

Facility or Activity	Range Type and Time Period																			
	Sagebrush				Birdfoot Sagewort				Greasewood				Grassland				Total			
	80	85	90	Total	80	85	90	Total	80	85	90	Total	80	85	90	Total	80	85	90	Total
Final Contour	170	337	79	586	2	26	51	79	1	58	--	59	2	6	--	8	175	427	130	732
	(170)	(507)	(586)		(2)	(28)	(79)		(1)	(59)	(59)		(2)	(2)	(8)		(175)	(602)	(732)	
Mine Facilities	51	6	--	57	--	--	--	--	--	3	--	3	3	--	--	3	54	9	--	63
	(51)	(57)	(57)							(3)	(3)		(3)	(3)	(3)		(54)	(63)	(63)	
Ancillary Facilities	14	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	14
	(14)	(14)	(14)														(14)	(14)	(14)	
Total	235	343	79	657	2	26	51	79	1	61	--	62	5	6	--	11	243	436	130	809
	(235)	(578)	(657)		(2)	(38)	(79)		(1)	(62)	(62)		(5)	(11)	(11)		(243)	(679)	(809)	

( ) = Cumulative Figures

designated would be used for housing sites and support service locations.

The total vegetative disturbance that would occur as a result of mining, development of mine and ancillary facilities, and population increases would be: 1978 to 1980—318 acres; 1981 to 1985—436 acres; 1986 to 1988—130 acres. The cumulative acreage disturbed for like time periods would be 318, 754, and 884 acres, respectively.

After the initial opening period, reclamation of the lands disturbed by mining would be accomplished at the same rate that disturbance occurs, which would be at an average rate of approximately 85 acres per year. The total acreage of land at any one time that would be unreclaimed is expected to be approximately 210 acres. The cumulative acres of mine area to be reclaimed would be 0 acres by 1980; 180 acres by 1985; 492 acres by 1990; and 764 acres by 2 years after the completion of mining and removal of mine facilities (approximately 1992). The 45 acres used in the development of drainage control dams would not be reclaimed since the reservoirs would be retained for livestock and wildlife use.

With the assumption that reclamation would be conducted as proposed in the reclamation plan and that revegetation would occur in the sequence as outlined in the guideline section, the following is a description of vegetative establishment that is expected to occur.

Vegetative type conversion to grassland type from the sagebrush and other types would likely occur on the reclaimed areas since it would be difficult to reestablish the plant species indigenous to the area by the seeding method. The replacement of only a minimal depth of topsoil and the expected alteration of soil structure and microclimate environment would not support vegetative production to premining level, nor would they be conducive to production of present plant species and composition during the life of the mine. The ultimate vegetative production capability of the reclaimed lands is expected to average approximately 495 pounds of air dry vegetation per acre. At the initial seeding, the soil productivity level is expected to be approximately 50% of the post mining potential, and vegetative establishment approximately 65% successful (see Figure HS3-1). This would result in a vegetative production of approximately 161 pounds per acre. Subsequent spot seeding, improvement of soil conditions, and further establishment of vegetative cover through resting the area would result in an average vegetative production of approximately 370 pounds per acre with an estimated composition of 85% grasses, 10% forbs, and 5% shrubs at the end of the 9½ year reclamation guideline outlined at the beginning of this chapter. At this point, adequate forage would be available for cattle grazing even though vegetative production would be considerably lower than the average of 650 pounds of air dry vegetation produced per acre before mining. This would be attainable since the reestablished vegetation would have a composition of 85% grasses as compared to 19% for the original vegetative cover.

Forage for sheep and wildlife would be inadequate due to vegetative composition of the reclaimed areas. The grassland type vegetation would furnish approximately 10% to 15% of wildlife dietary needs. With the passing of time (40 to 50 years) and proper management, further soil development would occur, and through natural plant succession, vegetative production would increase to the 495 pound per acre level and composition would change with a significant increase in shrub populations, a slight reduction of grass production, and a slight reduction in forb production. A vegetative composition similar to present day composition is expected to be attained on the area approximately 40 to 50 years after initial reclamation efforts. Since the management objective is to restore the lands as sheep range and wildife habitat in a timely manner, additional mitigation measures would have to be applied to reclaimed areas to attain the objective of post mining land use and requirements of the law.

Haul road dust and fugitive coal dust from mining, blasting, transporting, and loading may be deposited on vegetation adjacent to the activity area. Dust covered vegetation would be less palatable to livestock and wildlife during the life of the mine.

Another impact from the destruction of native vegetation could be the invasion of noxious weeds onto the disturbed areas. These weeds would compete with revegetation efforts and could inhibit the establishment of the desired vegetative cover.

Young palatable vegetation produced by revegetation efforts would attract livestock and wildlife. The grazing of the young plants would inhibit growth vigor and cause delay in the establishment of vegetative cover.

Endangered and/or Threatened

A field examination was made on the Hanna South project area on May 3, 1977, and no threatened or endangered plants were found. It was concluded that the chance of any endangered or threatened plants being present is near zero (BLM Memo, 4510 (932), July 22, 1977).

FISH AND WILDLIFE

General Information

Impacts to the wildlife resource can be classed into two general categories: (1) loss of habitat and the carrying capacity of that habitat; and (2) the loss of wildlife populations and their progeny, their progenie's progeny, and so on, for the length of time necessary to complete mining and reclamation.

The proposed mining operation would remove 2,800 acres of wildlife habitat. Vegetative types that would be disturbed (either directly, or indirectly by isolation) would be sagebrush--2,274 acres; birdfoot sagewort—273 acres; greasewood—214 acres; and grassland—39 acres.

Habitat Losses

The proposed mining operation would result in both direct and indirect losses of wildlife habitat. Direct losses include vegetative habitat that would actually be destroyed by the mining operation and the construction of ancillary facilities. Indirect habitat losses are those areas of habitat that would not physically be removed, but are areas outside the mined land that would become unusable by some wildlife species because of noise, lights, traffic, etc. This area could be called the "zone of influence"around the actual disturbed area.

Direct losses of habitat on the project area would be 243 acres by 1980 composed of 235 acres of big sagebrush (96%); 5 acres of grassland (2%); 2 acres of birdfoot sagewort (1%); and 1 acre of greasewood (1%). Losses of wildlife habitat by 1985 would total an estimated 679 acres of wildlife habitat composed of 578 acres of big sagebrush (85%); 62 acres of greasewood (9%); 38 acres of birdfoot sagewort (5%); and 11 acres of grassland (1%). Estimated losses of wildlife habitat by the end of mine life (year 1990) would total an estimated 809 acres made up of 657 acres of big sagebrush (81%); 79 acres of birdfoot sagewort (10%); 62 acres of greasewood (8%); and 11 acres of grassland (1%) (see Chapters 4, 5, and 6).

The loss of wildlife carrying capacity for various species would also be associated with the actual loss of habitat.

Wildlife Population Losses

Introduction

Because of mining activities in the area, some wildlife populations would be lost or reduced during the mine life period. These losses would increase as the size of the disturbed area increases during the period of mine life.

Fishery

There are no fisheries in the Hanna South project area; therefore, no losses are anticipated.

Wildlife

Birds

Nongame. The major small bird populations that would be lost or displaced by the loss of 809 acres of habitat would be Brewer's sparrow, sage sparrow, sage thrasher, and vesper sparrow.

The best population density estimate for the project area is an average of 21 breeding pairs (ranging from 8 to 40) per 100 acres, the population turning over every 3 years, and each pair fledging an average of three young per nest (personal communication, Max Schroeder, USFWS, April 1978).

It is not possible to calculate a good population estimate for small birds because there are not enough natural mortality data available from the literature to enable a computer simulation to be completed (see Chapter 6). However, assuming that small birds space themselves equally over the project area, estimates of small bird losses would total 20% of the population on the site. This loss would total a loss of less than 1% of the regional total.

In the reclamation plan it is proposed to return the vegetation to a perennial grass complex. This change in vegetation would alter the species makeup of the small bird population in the area. Habitat for sage thrashers, Brewer's sparrows, horned larks, etc., would be removed and grassland species such as lark buntings, meadow larks, etc., may filter into inhabit the area.

At the present time, there are no known raptor nests occurring on the project area. Therefore, adverse impacts to raptors would only be in the realm of loss of hunting habitat.

Game. Sage grouse would be the only game bird significantly impacted by the proposed mine. Construction of the ancillary facilities and the actual mining would result in the loss of about 2,800 acres of year-round sage grouse habitat. This loss of habitat would result in the displacement of a portion of the sage grouse population that occurs on the area. The 749 acres of crucial sage grouse nesting habitat located in the southern portion of the project area would not be physically disturbed. However, mine-related activities (e.g., dust, noise, vehicle travel, etc.) would cause enough harassment to push nesting grouse into less favorable habitat which would result in lowered production.

Assuming that female sage grouse are spaced evenly over the nesting habitat associated with the lek south of the project area, an estimated three nests would be located on the project area. Losses of grouse produced from these nests would total an estimated 17 birds by 1980, 60 by 1985, and 86 by end of mine life (year 1988). These estimates include the progeny that would have been produced had mining not taken place.

Mourning doves feed and nest on the proposed site, but the habitat is marginal at best because of the uniformly poor quality habitat throughout the area. No data exist at the present time as to numbers of birds nesting on the area or estimated production. It can be said, however, that approximately 809 acres of poor quality nesting habitat for doves would be lost over the life of the mine, but numbers of birds lost are not quantifiable at the present level of knowledge (see Chapter 6).

Mammals

Nongame. The removal of topsoil would cause direct mortality to the following primary species of nongame rodents; Uinta ground squirrel, least chipmunk, deer mouse, and Great Basin pocket mouse. Losses caused by these and other mine-related activities would not only be a result of direct mortality, but would also be a result of

displacement of more mobile rodents. These activities would cause a population decrease in the small mammal population on the project area.

Quantification of these losses by computer simulation is not possible at the present time because published mortality data for small rodents are rare, and not available at all for southcentral Wyoming. Losses of small rodents on 809 acres over the life of the mine would be heavy, but the high reproductive potential of these species indicates the repopulation of reclaimed mine areas would be rapid (see Chapter 6).

However, if it is assumed that small rodents would space themselves evenly throughout the project area, estimates of rodent losses from mining would total 20% of the small rodent population on the site. In addition, this loss is estimated to be less than 1% of the regional population. The planned revegetation of the mined area to a grass complex would result in a different small mammal population, since small rodents that frequent shrub habitat would not infiltrate back into a reclaimed area planted to grass (personal communication, Max Schroeder, U.S. Fish and Wildlife Service, March 1978).

Game. During the projected 10-year mine life, approximately 2,800 acres of year-round pronghorn range would be lost as a result of surface mining and ancillary facility construction. Mine associated activities and habitat losses would push the estimated twenty pronghorns that occasionally use the area into surrounding ranges. This displacement would not significantly reduce the pronghorn population.

Reclamation efforts aimed toward establishing a grass cover on the reclaimed sites would furnish some early spring forage for pronghorns. The amount of forage furnished would not enhance pronghorn range because of the small amount of grass utilized by these animals.

If the four retention ponds were left after mining ceases, they could be utilized by pronghorns for water sources throughout the summer.

Losses of pronghorns due to increased automobile traffic, increased poaching, harassment, and wanton destruction would all increase as a result of the enlarged human population in the area. These numbers are not quantifiable at the present time.

It is anticipated that about 2,800 acres of marginal year-round mule deer range would be lost as a result of mine facility construction and the actual surface mining during the 10-year mine life. If reclamation of the disturbed areas results in a vegetative type that is primarily grass, deer range in the project area would not be enhanced, since deer utilize grass only to a slight degree and then mostly in the spring (Kufeld et al. 1973). If the four retention ponds are left after mining is completed, additional water would become available for the estimated five deer found on the site.

Deer would be displaced from the mine activity area into adjacent habitat to the south and east. Significant losses of deer as a result of this displacement are not anticipated because of the low number of animals involved. However, losses of deer due to deer/automobile collisions, harrassment, poaching, and wanton destruction would increase as a direct result of increased numbers of people in the area.

Removal of 809 acres of brushland habitat would result in a population loss to desert cottontail rabbits. In this area, there is an estimated density of 5 rabbits per acre (Wyoming Game and Fish Department 1978). Cumulative losses of cottontail rabbits cannot be calculated since mortality data needed for a computer simulation are not available. While losses would be heavy during mine life, the high reproductive potential of this species would enable it to quickly repopulate the area after reclamation is completed (see Chapter 6).

However, if it can be assumed that cottontails would space themselves equally throughout the project area, losses due to mining would total an estimated 20% of the population on the project area. This estimated loss would also be less than 1% of the regional population.

Reptiles and Amphibians

General. The only reptile that has been observed on the project area is the northern shorthorned lizard. However, there is a potential for 18 species of reptiles to occur on the site according to literature sources (Cochran and Goin 1970).

Data on population densities and mortality rates are not available for this area or any area that is similar so computer simulations of population losses cannot be run. Reproduction in these species is high enough so that repopulation would be rapid once reclamation is completed (see Chapter 6).

The significance of these losses can be estimated if it can be assumed that these species space themselves equally throughout the project area. Estimates of these losses would be 20% of the population on the site. In addition, these losses would be less than 1% of the regional population.

Amphibians apparently do not occur on the site since there is a lack of adequate surface water for habitat.

Feral (Wild) Horses

No impacts are anticipated to feral horses, since none occur on the project area.

Endangered and/or Threatened

No federally listed endangered or threatened mammal species are known to inhabit the project area. At this time, and with current data, it is not anticipated that any adverse impacts would occur to any mammal species in these categories.

However, in accordance with Section 7 of the Endangered Species Act of 1973, formal consultation with the U.S. Fish and Wildlife Service has been requested concerning the possibility of black-footed ferrets being found in this area.

At the present time, there are no adverse impacts anticipated to any bird species since it appears none occur on the site. However, in accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter of August 11, 1978.

No adverse impacts are anticipated to any threatened or endangered reptile or amphibian, since it appears none are found on or near the area.

CULTURAL RESOURCES

Six sites in the Hanna South project area need further testing to determine their eligibility for nomination to the National Register. If any sites, after testing, and after consultation with the SHPO and the Advisory Council on Historic Preservation, are determined to be of National Register quality, 106 Compliance will be completed.

Sites located along rights-of-way and permit areas associated with the Hanna South project area would also be handled under 106 compliance procedures.

Subsurface sites, which cannot be located prior to mining, may be impacted by mining operations.

VISUAL RESOURCES

Visual resource contrast ratings were derived for the Hanna South project area using places along U.S. Highway 30 and State Highway 72 as critical viewpoints (Map HS2-6). These contrast ratings, summarized in Table HS3-9, are available for review at the Rawlins District Office of the BLM. Further explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is available in the library of the Rawlins District Office of the BLM.

Contrast ratings are assessed in terms of how the proposed action would affect the basic elements (form, line, color, and texture) of the existing landscape features, i.e., landform, vegetative patterns, and structures. Resultant contrast ratings are then compared to the maximum acceptable impact limit for the visual resource management (VRM) class as seen from a viewpoint. Two time periods (during active mining and post reclamation) were used for the Hanna South Mine contrast ratings.

Viewpoints A, D, E, and G

From these viewpoints, most of the project area is visible. Mining activities and structures in the Class III area would create strong contrast to all basic elements. The visual resource management class would change to a Class V in the actual mining area.

Viewpoints B to C and F to C

All mining activities and structures would be visible from this stretch of road. The contrast ratings indicate that the proposed coal mining would create strong contrast to line, form, color, and texture. Spoil piles, pit headwalls, coal storage, and topsoil piles would be visible along these stretches of U.S. Highway 30 and State Highway 72. These activities would change the visual resource management class from a Class III to a Class V.

RECREATION RESOURCES

Visitor Use Data

Table HS3-10 depicts estimated resident visitor use changes by activity due to coal mining in years 1980, 1985, and 1990. The changes are those which would occur in the region and result from increased population in Carbon County. Data used to calculate use are available in the files at the BLM's Rawlins District Office.

Hunting

Impacts to hunting would result when restricted access to or displacement of deer, antelope, rabbits, rodents, coyotes, and game birds result as construction and mining destroy wildlife habitat (see Fish and Wildlife Section). With an increased number of people in the region, some ranchers would restrict access across private lands. Increased human population would induce a greater demand for hunting and decrease the quality of the hunting experience in the region.

Sightseeing

The construction and mining would cause adverse impacts to existing recreational sightseeing values in the area. There would be impacts to zoological sightseeing due to the displacement of wildlife species. There would be opportunities for geological and industrial interpretation.

Specialized Activities

Off-road vehicle use by four-wheel drive enthusiusts would be restricted from the mining area for safety reasons.

General

With an increased visitor use due to increased population in Carbon County, there would be a general lowering of the quality of the outdoor recreation experience in the region surrounding the Hanna South project area. There would also be increased use in urban recreation in

Table HS3-9

SUMMARY OF VISUAL CONTRAST RATINGS FROM CRITICAL VIEWPOINTS

Views From Critical Viewpoints	A	B-C	D	E	F-C	G
Visual Management Class	III	III	III	III	III	III
During Active Mining (Land)	3/20	3/26	3/20	3/20	3/26	3/20
Post Reclamation (Land)	2/17	2/19	2/17	2/17	2/19	2/17
During Active Mining (Vegetation)	3/30	3/30	3/30	3/30	3/30	3/30
Post Reclamtion (Vegetation)	3/20	3/23	2/15	3/20	3/23	3/20
During Active Mining (Structures)	2/20	3/27	2/20	2/20	3/27	2/20
Post Reclamation (Structures)	1/10	2/12	1/10	1/10	2/13	1/10

In a visual resource management Class III area, the maximum acceptable impact should not exceed 2/16.

Table HS3-10

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO POPULATION CHANGE FOR YEARS 1980, 1985, 1990

	Fishing	General**	Hunting	Off-road vehicles	Urban recreation***	Water Sports****	Winter Sports*****
1977	75,554	96,984	23,974	2,902	46,131	34,872	9,263
1980 (population 117)*							
without proposed action	91,809	117,947	28,299	3,452	58,974	43,420	12,097
increase due to proposed action	497	639	153	19	319	236	66
total projection	92,306	118,586	28,452	3,471	59,293	43,656	12,163
% of projection	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
1985 (population 386)*							
Without proposed action	112,269	146,492	33,706	4,144	77,005	55,227	16,594
increase due to proposed action	1,671	2,182	502	61	1,147	822	247
total projection	113,940	148,674	34,208	4,205	78,152	56,049	16,841
% of projection due to proposed action	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%

Table HS3-10

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO
POPULATION CHANGE FOR YEARS 1980, 1985, 1990
(Continued)

	Fishing	General**	Hunting	Off-road vehicles	Urban recreation***	Water Sports****	Winter Sports*****
1990 (population 417)*							
without proposed action	129,450	170,828	38,422	4,719	92,507	65,318	20,097
increase due to proposed action	1,827	2,411	542	67	1,305	921	284
total projection	131,277	173,239	38,964	4,786	93,812	66,239	20,381
% of projection due to proposed action	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%

* Population changes due to project (socioeconomic section)

** General includes camping, picnicing, sightseeing, etc.

*** Urban includes rodoes, golfing, and attending athletic events

**** Water sports includes boating, swimming, and water skiing

***** Winter sports includes only skiing

the towns of Hanna and Saratoga and the city of Rawlins.

AGRICULTURE

Livestock Grazing

The proposed mine development lies completely within the Dana Meadows South grazing allotment. Due to the location of U.S. Highway 30 and the Hanna-Elk Mountain road (State Highway 72), the project area is divided roughly into quadrants. The period of time that each quadrant would be lost to grazing would vary. Mining would begin in the southwest quadrant and progress through the southeast quadrant, the northeast quadrant, return to the southwest, and terminate in the northwest quadrant. The surface facilities (office, shop, etc.) would be located in the southwest quadrant. Due to the location of the area to be mined and the location of mine facilities, some undisturbed vegetation would be isolated from grazing while operations were being conducted in the individual quadrants.

As outlined in Assumptions and Guidelines, vegetative cover would be established 4½ years after initial seeding. Under the reclamation procedures as outlined in the proposed action, the resulting vegetative cover would be principally grasses (Chapter 3, Vegetation) and would be most suited for grazing of cattle. However, since the objective of reclamation is to return the land to its premining use of sheep grazing and wildife habitat, the vegetation would not be that desired for these uses at this point of time. The time period needed to acquire vegetation similiar to premining vegetation would be greatly extended. It is estimated that it would take 40 to 50 years for the natural succession process to establish the desired vegetative species and composition suitable to graze sheep and meet wildlife habitat criteria.

All use of the reclaimed areas by livestock and big game would have to be controlled to attain the desired vegetative composition through natural succession. As a result, grazing loss would be sustained on the isolated undisturbed areas as well as the reclaimed areas. Under this premise, premining uses would not be fully restored until 2034. Grazing loss in animal unit months (AUMs) by time periods would be approximately 83 AUMs by 1980; 707 AUMs by 1985; 1,985 AUMs by 1990; and 13,061 AUMs by 2034. Table HS3-11 displays this loss by years and time periods.

Due to the location of the proposed mine areas in relation to each other and their locations within a quadrant, it would not be practical to release reclaimed lands to grazing on a year to year basis. It would be more advantageous to release areas to grazing on a quadrant basis as depicted in Table HS3-11.

One stockwater reservoir would be destroyed by the mining operations. This destruction would not affect the grazing of areas adjacent to the mining areas since other water sources would be available such as the drainage control structures that would be constructed and retained.

MINERAL RESOURCES

Coal

The two impacts associated with mining would be the removal of 6.1 million tons of coal and the loss of 1.2 million tons of coal that would be unrecoverable (left in the ground) due to mining methods. Losses would be primarily caused by dilution with waste material at the top and bottom of the coal seam.

Sand and Gravel

An estimated 1,500 cubic yards of sand and gravel would be needed for concrete aggregate in construction of the mine facilities.

Scoria

Assuming that 6,000 cubic yards would be required per mile of road, the 12.9 miles of haul road would require 77,400 cubic yards of scoria.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

The land in this area is zoned for ranching, agriculture, and mining, with the exception of a scenic corridor extending 2,000 feet on each side of U.S. 30 and State Highway 72, which would be impacted by the proposed mining. See Visual Resources map in Chapter 2 (Map HS2-6). The zoning; however, does not legally preclude mining within the scenic corridor.

SOCIOECONOMICS

Demographics

Population

The proposed Hanna South Mine would result in a population increase of 381 people in Carbon County, most of whom would enter the area between 1979 and 1985 (Table HS3-12). The new population would reside primarily in Rawlins, the Hanna/Elmo area, Saratoga, and Medicine Bow. Rawlins, which is located 40 miles west of the proposed mine, would receive much of the population increase. With the mine, the 1985 population

Table HS3-11

MATHEMATICAL PROJECTION OF ANIMAL UNIT MONTHS OF GRAZING LOSS
WITH DEVELOPMENT OF HANNA SOUTH PROJECT

Year or Period	Acres Removed From Grazing		Acres Returned To Grazing		Acres out of Production	AUMs Lost	
	Yearly	Cumulative	Yearly	Cumulative		Yearly or by Period	Cumulative
1979	300	300			300	30	30
1980	230	530			530	53	83
1981	200	730			730	73	156
1982	225	955			955	96	252
1983	225	1,180			1,180	118	370
1984	400	1,580			1,580	158	528
1985	210	1,790			1,790	179	707
1986	200	1,990			1,990	199	906
1987	400	2,390			2,390	239	1,145
1988	310	2,800			2,800	280	1,425
1989					2,800	280	1,705
1990					2,800	280	1,985
1991 to 1995					2,800	1,400	3,385
1996 to 2000					2,800	1,400	4,785
2001 to 2005					2,800	1,400	6,185
2006 to 2010					2,800	1,400	7,585
2011 to 2015					2,800	1,400	8,985
2016 to 2020					2,800	1,400	10,385
2021 to 2025					2,800	1,400	11,785
2026			380	380	2,420	242	12,027
2027				380	2,420	242	12,269
2028			550	930	1,870	187	12,456
2029				930	1,870	187	12,643
2030			610	1,540	1,260	126	12,769
2031				1,540	1,260	126	12,895
2032			430	1,970	830	83	12,978
2033				1,970	830	83	13,061
2034			830	2,800	0	0	13,061

Table HS3-12

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

County City	1977 Population	1980		1985		1990	
		Total with the Proposed Action	Impact of the Proposed Action	Total with the Proposed Action	Impact of the Proposed Action	Total with the Proposed Action	Impact of the Proposed Action
Carbon County	18,137	21,694	117	26,284	381	29,911	381
Rawlins	10,500	13,613	53	17,083	211	20,170	211
Sinclair	550	560	0	571	2	578	2
Hanna/Elmo*	1,500	1,851	38	2,228	100	2,447	100
Elk Mountain	220	244	2	270	7	282	7
Medicine Bow	750	857	9	940	22	988	22
Saratoga	2,050	2,160	11	2,279	30	2,346	30
Encampment	500	523	4	565	9	586	9

* These towns are located several miles apart and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Research Institute, Laramie, 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

in Rawlins would be about 1.3% greater than the 1985 population of 16,872, which is expected without further federal coal actions. This additional population increase would occur during a period (between 1977 and 1985) when Rawlins would experience a moderate average growth rate of 6.1% due to current coal development in the Hanna Basin and anticipated development of Red Desert area uranium mines.

Population in the Hanna/Elmo area, which is in the immediate vicinity of the proposed mine, would be 4.6% greater in 1985 with the proposed mine than the population of 2,128 expected without the mine.

Employment

Construction of the proposed Hanna South project would take place in 1979 and 1980. Production would begin in 1980 and a permanent work force of 100 would be employed over the 10 year life of the mine.

Mineral and mine related construction workers receive higher wages than employees in other sectors of the economy, so the Hanna South Mine would be in a favorable situation to compete with other employees in the region for the available labor supply. This may actually lead to a slower growth in employment in other sectors of the economy for the years immediately following the mine employment increases. In 1980 there would be 120 workers (100 miners and 20 construction workers) employed at the Hanna South Mine. However, total employment in the region would only increase by 53 (Table HS3-13) workers, so the mine employment would cause a net decline of 67 workers in other sectors of the economy. This impact would be felt most strongly in agriculture, retail trade, services, and some local government departments (e.g., police and fire) where wages are traditionally low. This would be a temporary situation which would disappear when migration increased the available labor supply sufficiently to supply potential employers.

In a report by F.L. Leistritz and T.A. Hertsgaard, it was shown that when industry (coal development) moves into a rural area, farm and ranch operators are faced with the necessity of offering higher wages or reorganizing their farms or both. Operators of small farms and ranches who have been underemployed in their farm or ranch business may take advantage of the new off-farm job opportunities that coal development provides.

Operators who are fully employed with adequate incomes from agriculture and who do not hire much extra labor would be least affected by increased competition for labor. Those operating large farms and ranches requiring large amounts of labor would be likely to make significant adjustments in their operations. These adjustments would likely include dropping certain labor-intensive enterprises, adopting labor-saving technologies, and perhaps even reducing the size of their operation.

New mining activity creates a need for additional employment in industries which serve the mine (e.g., mine supply firms) and in businesses and organizations which serve the new mine and mine-related employment (e.g., merchants, storekeepers, and school teachers). By 1990, the Hanna South Mine would create 174 new jobs in the Carbon County economy, which represents a total employment to direct mine employment ratio of about 1.7 (Centaur 1978).

Income

The proposed Hanna South project would increase personal income in the region $6.9 million (in constant 1977 dollars) by 1990 because of increased wage earnings ($4.3 million) and proprietor's income ($2.6 million). This would be an increase of 1.8% over the 1990 personal income expected without the proposed action. With 174 additional workers employed in 1990 as a result of the proposed action, the $4.3 million rise in personal income represents an increase of $24,700 (in constant 1977 dollars) per additional worker (Centaur 1978).

This increase in income would create local inflationary pressures. This would occur because the miners and mine related employees would have more money to spend on goods and services than would others. This would affect those on fixed incomes (retirees, welfare recipients, etc.) more than anyone else. As incomes and prices rise rapidly, their incomes do not, effectively reduces their buying power.

Infrastructure

Private Sector

The increase in personal income in the region that would result from the Hanna South project would generate additional wholesale and retail sales. These additional sales would be $0.8 million in 1980, $2.1 million in 1985, and $2.9 million in 1990 (in constant 1977 dollars) (Centaur 1978).

Along with these increased sales, there would be diversification of business types to take advantage of the new sales opportunities. New business would locate in the region that have not been represented in the local economy previously.

Although only 60% of the population increase resulting from the Hanna South project would live in Rawlins, a much higher percentage of sales would occur there because of Rawlins' position as the major trade center in the region.

Housing

The proposed Hanna South project would create an additional housing demand of 225 units (92 single family units) by 1990 (Centaur 1978). About 60% of this demand would be felt in Rawlins.

Housing demand is based on the historical relationship of 2.7 persons per housing unit in Carbon County. Housing shortages, which would be reflected by occupancy rates greater than 2.7 persons per housing unit, are difficult to anticipate. No major constraints to rapid expansion of mobile homes are known; trailer parks can be

Table HS3-13

SOUTHCENTRAL WYOMING EMPLOYMENT

Sector	1977 Total Employment	1980 Total with the Proposed Action	1980 Impact of the Proposed Action	1985 Total with the Proposed Action	1985 Impact of the Proposed Action	1990 Total with the Proposed Action	1990 Impact of the Proposed Action
Farm	526	525	0	525	0	525	0
Manufacturing	360	386	0	427	0	468	0
Mining	1,658	2,462	+100	2,902	+100	2,828	+100
Construction	715	1,059	+5	1,144	+12	1,500	+12
Government	919	1,005	-13	1,437	+18	1,772	+18
Farm and Forest Processing	46	47	0	48	0	49	0
Railroads	480	540	0	680	0	780	0
Business Services	1,415	1,568	-21	2,025	+20	2,453	+20
Consumer Services	1,948	2,084	-18	2,500	+24	2,901	+24
Total Employment	8,067	9,676	53	11,688	+174	13,276	+174

Note: The impact of the proposed action is the difference between total employment with proposed action and total without the proposed action.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming Water Resources Research Institute, Laramie, 1978.

built quickly and financing has not been unduly difficult to obtain. Water and sewer moratoriums in several communities have been lifted due to new construction which has increased capacities.

Some new residents are likely to rent rooms in existing homes, live temporarily in motels, or share rental units with others because they prefer those alternatives to mobile homes or because they are waiting for other housing to become available.

Demand for single family homes is estimated based on the expected preferences of new residents and long-time residents. New residents are often reluctant to purchase or build homes, so they would exhibit fewer demands for single family homes than those who have lived in the community for a number of years. The supply of single family homes is not expected to rise sufficiently to meet this increased demand. Single family shortages now exist (partially the result of past construction moratoriums) and would likely become larger as a result of the proposed action.

Education

School-age population in District 01 would increase by 68 by 1990. School-age population in District 02 would increase by 46 (Centaur 1978). The schools most affected would be in Rawlins (District 01) and in Hanna (District 02). The Rawlins schools, as well as the Hanna Junior-Senior High school, have adequate capacity to absorb projected increased. The elementary school in Hanna is near capacity and some overcrowding would occur.

The assessed valuation of School District 02 would be increased by the value of the mine property.

Health Care and Safety

The level of health care in Carbon County is currently inadequate with fewer physicians and dentists available than are needed by the existing (1977) population. With the proposed action, the present inadequate availability of health care specialists would worsen slightly. By 1990 the Hanna South project would lead to a need for one additional registered nurse (Centaur 1978).

The Memorial Hospital in Rawlins has a capacity of about 29,000 to 33,000, compared to Carbon County's 1977 population of 18,137. Even with the additional 417 people that would come into the region as a result of the Hanna South project, the hospital would still have considerable excess capacity.

In 1974, the incidence of work-related injury or illness in Wyoming for all industries was 10.4 cases per 100 full-time workers (this is the same incidence rate as the the United States as a whole—U.S. Department of Labor 1976). Bituminous coal mining in Wyoming appears much safer than the average industry with 5.2 cases of injury or illness per 100 full-time workers (in the United States, the incidence rate for bituminous coal mining is 10.6 cases per 100 full-time workers). If the incidence rate for injury and illness in bituminous coal mining holds in the future, the additional coal mining at the Hanna South Mine would increase injury and illness by an average of 5.2 cases per year. An unquantifiable number of these would be fatal or debilitating. Because bituminous coal mining appears safer than the average industry, this increase in injury or illness is less than would be expected from employment increases in other sectors of the economy.

Local Services

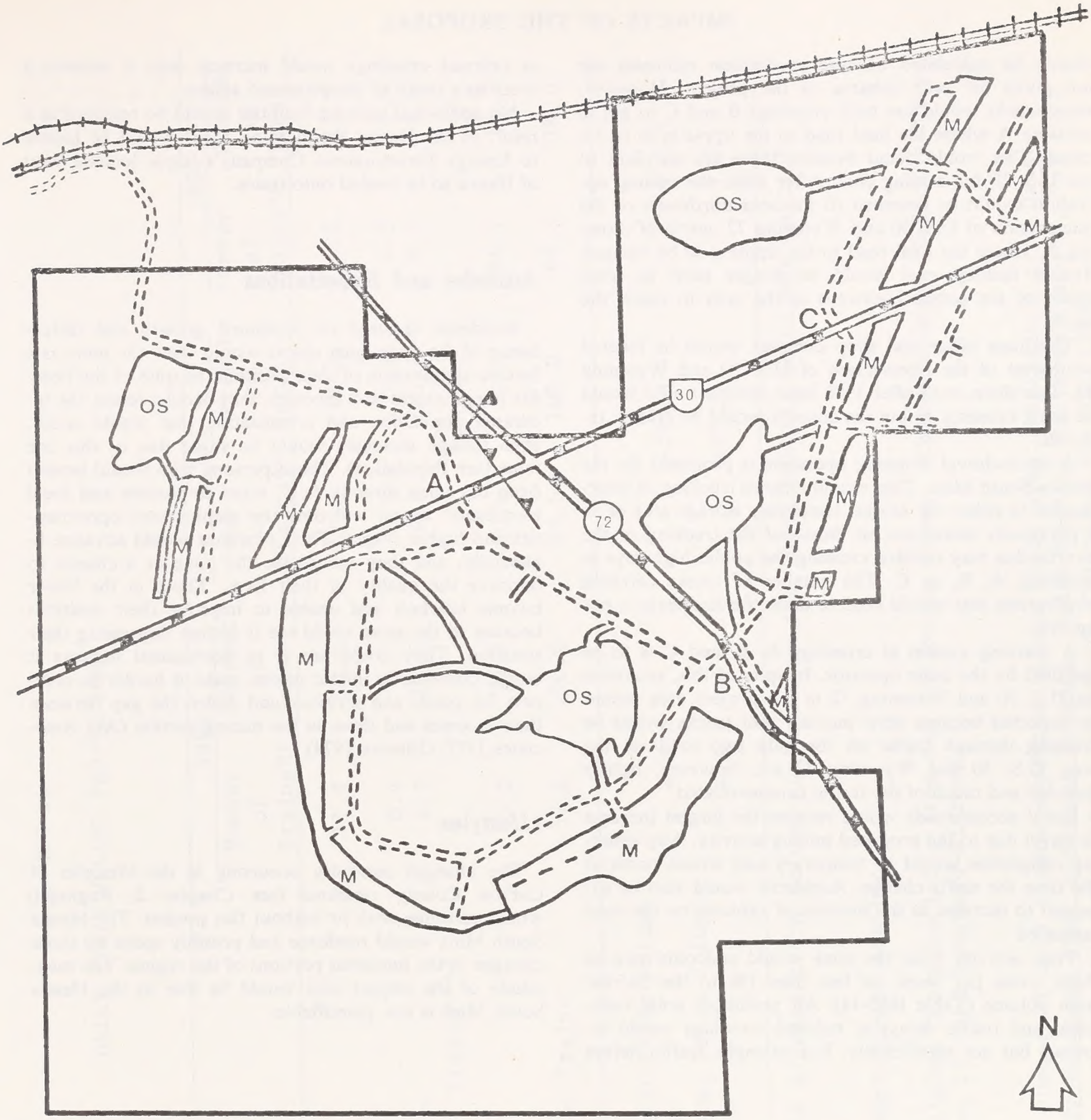
The proposed Hanna South project would lead to increased population in Rawlins, the Hanna/Elmo area, Saratoga, Medicine Bow, and other Hanna Basin area communities, placing additional demands on the local services (water, sewer, police, fire protection, and solid waste) these communities provide to their residents. Because the expected regional population increase of 417 due to the proposed action would be small in comparison to the anticipated total regional population growth between 1977 and 1990 of 11,827, the impacts on the local community services attributable solely to the proposed action would be insignificant.

Transportation and Utilities

Highway access to the Hanna South Mine area is via U.S. Highway 30 and Wyoming 72. Both of these highways are two lane, paved roads. The mine area lies on all four sides of the intersection of these highways. A 900 foot access road, designed and built by the mine operator to county specifications, would connect the mine area to these highways. Map HS3-7 shows the site layout of the Hanna South proposal.

Interaction between mining vehicles and traffic on the two highways in the area would take place at three points. The first, labeled A on Map HS3-7, is west of the intersection of U.S. 30 and Wyoming 72. The haul road leading to the Energy Development Company's tipple, the coal's initial destination, is located on the north side of this intersection of the haul road and U.S. 30. The second point of interaction between mining vehicles and normal traffic, labeled B on the map, is located southeastward from the intersection of U.S. 30 and Wyoming 72. It is the intersection of a haul road and Wyoming 72. The last point of intersection, labeled C, is the intersection of a haul road and U.S. 30 east of the intersection of U.S. 30 and Wyoming 72.

During the initial phase of mining operations, about 276 coal trucks would cross U.S. 30 daily at crossing A (based on an estimated average yearly production of 794,660 tons of coal, 23-ton coal trucks, 250 working days, and each truck making a round trip). In the second phase, 1981 to 1985, about 212 coal trucks would use crossing A daily (based on an estimated average yearly production of 611,752 tons of coal, 23-ton coal trucks, 250 working days, and each truck making a round trip). When the mining operation extends to the east side of Wyoming 72 on both the north and south sides of U.S. 30 during this time period, crossings B and C would also be used. The number of trucks crossing at these points



Railroad Spur
Mainline Railroad
Project Boundary
Federal & State Highway
Haul Road
Overburden Haul Road
Power Line
M Mining Area
OS Overburden Storage
A,B,C Crossing points of haul roads and highways

Map HS3-7

SITE LAYOUT OF HANNA SOUTH MINE

cannot be calculated because production estimates are not given for each subarea of the project. However, some trucks would use both crossings B and C to get to crossing A where the haul road to the tipple is to be located. This would occur because there are no plans to use U.S. 30 for hauling coal. After 1986, the mining operation would be contined to the area northwest of the intersection of U.S. 30 and Wyoming 72, north of crossing A, where the haul road to the tipple is to be located. Trucks hauling coal would no longer need to cross either of the public highways in the area to reach the tipple.

The mine office and shop complex would be located southwest of the intersection of U.S. 30 and Wyoming 72. Therefore, even after 1986 some mining traffic would be using crossing A, but the amount would be greatly reduced.

A truck-shovel stripping operation is proposed for the Hanna South Mine. This would require trucking of overburden to either the nearest temporary storage area or to a previously mined-out pit. Some of the trucking of the overburden may involve crossing the public highways at crossings A, B, or C. The number of trucks carrying overburden that would need to cross the highways is not known.

A warning system at crossings A, B, and C is to be installed by the mine operator. In spite of this, accidents on U.S. 30 and Wyoming 72 in the project area would be expected because slow moving coal trucks would be crossing through traffic on the only two roads in the area. U.S. 30 and Wyoming 72 are, however, lightly traveled and much of the traffic is mine-related.

Local access roads would receive the largest increase in travel due to the proposed mining activity. Any resulting congestion would be temporary and would occur at the time the shifts change. Accidents would also be expected to increase as the number of vehicles on the road increased.

Train activity from the mine would add only two to three trains per week, or less than 1% to the current train volume (Table HS3-14). Air pollution, noise emissions, and traffic delays at railroad crossings would increase, but not significantly. For example, traffic delays at railroad crossings would increase only 8 minutes a week as a result of the proposed action.

No additional railroad facilities would be required as a result of the Hanna South Mine. Coal would be hauled to Energy Development Company's tipple located west of Hanna to be loaded onto trains.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income), they would resent the increased population and urbanization that would occur, even though increases would be slight due to this one mine (see Population). Those persons who would benefit from the mine directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining section (Abt Associates 1977; Gilmore 1974).

Lifestyles

The changes currently occurring in the lifestyles of Carbon County residents (see Chapter 2, Regional) would continue with or without this project. The Hanna South Mine would reinforce and possibly speed up those changes in the impacted portions of the region. The magnitude of the impact that would be due to the Hanna South Mine is not quantifiable.

Table HS3-14

DAILY TRAIN VOLUME PROJECTIONS*

Train Type	1980 Number of Trains**	1980 Percent of Total	1985 Number of Trains**	1985 Percent of Total	1990 Number of Trains**	1990 Percent of Total
Total Coal Trains:	11.9	20.8	12.0	19.2	11.8	17.3
Hanna South Mine	0.4	0.7	0.3	0.5	0.3	0.4
Hanna Basin Coal Trains***	6.5	11.4	6.7	10.7	6.5	9.6
Southwestern Wyoming Coal Trains****						
Non-coal Freight Trains	45.2	79.2	50.6	80.8	56.7	82.7
Total Coal and Non-coal Freight Trains	57.1	100.0	62.6	100.0	68.5	100.0
Percent Increase from 1977 Total Train Volume Excluding Hanna South Mine	+13.4		+24.6		+36.4	
Percent Increase from 1977 Total Train Volume Including Hanna South Mine	+14.2		+25.2		+37	

* These figures represent the average train volume projected on the Union Pacific mainlines east of Rawlins.

** Reflects both loaded and empty train traffic.

*** Reflects production and related train activity from the following mines: Carbon County, Medicine Bow, Rosebud, Seminoe I, Seminoe II, and Vanguard-Rimrock.

**** Reflects the most likely number of coal trains expected in the study area. Estimated from Data on Transportion of Coal By Railroad From Southwest Wyoming, Union Pacific Railroad Company, May 1978 and conversation with Ron Duttion, ABT Associates, Englewood, Colorado, May 18, 1978.

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

This chapter includes mitigating measures and other regulations designed to lessen the potential impacts of the proposed action upon the existing environment. Each impact is listed under the environmental element to which it would occur, along with applicable regulations, an analysis of their effectiveness, and any remaining residual impact. Only those impacts to which mitigation or regulations apply are discussed; Table HS4-1 presents a summary of all impacts.

MITIGATION GUIDELINES

Reclamation

In order to meet the requirements of SMCRA in regard to land reclamation, the measures outlined herein would be incorporated into the reclamation plan. Those measures listed as discretionary would not be required, but if adopted would aid in establishment of vegetative cover. These measures would: (1) reduce the time required for successful reclamation to about 15 years, (2) establish an approximate natural vegetative species composition for use by livestock and wildlife, (3) establish a more dense vegetative cover which would reduce wind and water erosion, and (4) provide for the protection of reclaimed areas from grazing until desired vegetative cover is established.

Since successful reclamation has not been fully demonstrated on the existing coal mines in the ES region, it is proposed that demonstration areas be established. These areas would be established on selected sites on existing mines where reclamation procedures are being applied. These areas would be used to verify whether or not the reclamation measures listed below would result in reclamation meeting the SMCRA standards (see Chapter 8).

Proposed Measures

1. Unsuitable overburden shall be separated, stored, and buried beneath suitable overburden. All unsuitable overburden or toxic material shall be buried 6 to 8 feet or more.
2. All topsoil material will be replaced to an average depth of 12 inches or more.
3. All seedbed preparations, beginning with topsoil replacement, seeding, planting, and all conservation practices initiated will be done on the contour.
4. Contour terraces or other soil and water conservation structures will be constructed on all slopes recommended by, and to the specifications and design of the appropriate agency.
5. Snow fence panels (5 to 6 feet in length and 3 feet high) or bales of hay set on the cut edge will be placed perpendicular to the prevailing wind at random intervals over reclaimed areas having 3% or less slopes. Placement of snow catchment structures will not be less than 60 per acre. After bales have been in place through two winters, they will be used as mulch in newly reclaimed areas.
6. Application of mulching materials to seeded areas will be done at the minimum rate of 2 tons per acre (native hay or straw). Native hay or straw used as mulch or for snow catchment must be certified as noxious weed free.
7. All mulch material will be anchored to the ground by crimping with a notched coulter to a depth of 5 inches or more or covering with a suitable netting material except slopes where steepness is prohibitive (See measure 12).
8. All drill seeding will be done with a rangeland drill with depth bands attached. All seeding will be at a minimum rate of 13 to 15 pounds of pure live seed (PLS) per acre.
9. Recommended seed mixture and seeding ratio (pounds PLS/acre) is shown on Table HS4-2.
10. All seeding shall be done when soil conditions permits after October 1st and before April 30th.
11. Open areas between contour furrows or contour terraces on south and west facing slopes will be planted with seed mixture only and not receive potted shrubs.
12. All areas that are too steep to be seeded by a rangeland drill will be seeded by broadcast method at a rate of 1½ times the drill seeding rate and the mulch manually applied and anchored with a netting, wire mesh, or other suitable material.
13. Planting of potted shrubs will be done in a random manner in accordance with Table HS4-3.
14. Planting of potted shrubs will be done in spring as soon as soil conditions permit (frost free period prior to April 30th).
15. All potted shrubs will be watered while the plant is being planted with an amount to saturate the planting root zone to avoid root dehydration and insure soil-root contact. Minimum application will be 1 gallon per plant. A water soluable fertilizer-root stimulant shall be added at the manufacture's recommended rate to the water used for shrub plantings. This additive would increase

Table HS 4-1

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Climate	N/A*	N/A	N/A	N/A	N/A
Air Quality					
AQ-1	N/A	N/A	N/A	N/A	All
AQ-2	N/A	N/A	N/A	N/A	All
AQ-3	N/A	N/A	N/A	N/A	All
Geology					
GE-1	N/A	N/A	N/A	N/A	All

*Not applicable, that is no portions of SMCRA or other regulations apply to the specific impact; therefore no other columns on the table apply.

Table HS 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Topography					
TO-1	30 CFR 715.14	N/A	Grading and contouring in reclamation plan	Area would be returned to original topography	None
Soils					
SO-1	N/A	N/A	N/A	N/A	All
SO-2	30 CFR 715.16	3041 & 211	Revise reclamation plan to to provide for retention of premining levels of soil productivity	Post-mining potential soil productivity levels equal to premining levels	Soil productivity would be lost on disturbed lands until reclaimed
SO-3	30 CFR 715.13 30 CFR 715.14 30 CFR 715.16 30 CFR 715.20	3041 & 211	Revise reclamation plan to provide for reductions in erosional rates	An estimated 75% reduction in erosional rates	An estimated 25% of erosional losses would continue
SO-4	N/A	Mining and reclamation plan and EPA	None	An estimated 50% reduction in fugitive dust (soil loss) from haul road	An estimated 50% of haul road dust as residual would remain

Table HS 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Soils (continued)					
SO-5	30 CFR 715.14 30 CFR 715.16(c) 30 CFR 715.16	3041 & 211	None	An estimated 75% reduction of erosion on topsoil storage areas	An estimated 25% residual erosion on topsoil storage areas would reamin. Increased amount of erosion off of overburden piles
SO-6	30 CFR 715.14(j)	3041 & 211	Revise reclamation plan to bury all contaminated soils	Burial of contaminated soil would be 100% effective	None
SO-7	30 CFR 715.14	3041 & 211	Revise reclamation plan to miminize erosion rates	An estimated 75% reduction in in erosional rates	An estimated 25% residual erosion soil losses would continue
SO-8	30 CFR 715.14(j)	3041 & 211	Revise mining and reclamation plant to provide for the separation and burial of unsuitable overburden and parting material beneath the suitable overburden	Separation and burial of unsuitable overburden and parting material as well as mixing of possible toxic material would be 100% effective	None
SO-9	30 CFR 715.18(b)	3041 & 211	Retention of drainage control dams (4)	Utilization of soil resource for a higher use	N/A

Table HS 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Water Resources					
WR-1	30 CFR 715.17	N/A	Replacement or rebuilding of facility	Would alleviate impact	None
WR-2	30 CFR 715.17	N/A	Replacement or rebuilding of facility	Would alleviate impact	None
WR-3	N/A	N/A	N/A	N/A	All
Vegetation					
VG-1	N/A	N/A	N/A	N/A	Loss of native veget-ation on 809 acres
VG-2	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 & 211	Revise reclamation plan to provide for establishment of vegetative cover of native species in a timely manner	Reduce time of establishment of vegetative cover of native species to 10 to 15 years	Loss of native vegeta-tive cover for 10 to 15 year period
VG-3	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 & 211	Revise reclamation plan to provide for revegetation in a manner that is timely and and encourages a prompt vegetative cover and recovery of productivity levels	Reduce time of establishment of vegetative cover and recovery of productivity levels to 10 to 15 years.	Loss of native vegeta-tion and productivity for 10 to 15 year period

Table HS 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Vegetation (continued)					
VG-4	N/A	EPA	None	Control of haul road dust and fugitive coal dust would be 50% effective	Palatability of vegetation would be effected for a 10 year period
VG-5	None	State of Wyoming	Revision of reclamation plan to provide for control of noxious weeds.	Noxious weeds would be controlled	None
VG-6	N/A	N/A	N/A	N/A	Loss of native vegetation on 75 acres
VG-7	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 & 211	Revision of reclamtion plan to provide measures that would assure the recovery of vegetation production levels in a timely manner	Application of addition mitigating measures for soil and vegetation could result is full recovery of vegetative productivity	None

Table HS 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Fish and Wildlife					
WL-1	30 CFR 715.13(a) 30 CFR 715.20(e)	N/A	All disturbed areas shall be restored in a timely manner Vegetative cover of species native to the area shall be established fullfill the needs of native wildlife	Will shorten the reclamation period from 40 to 50 years down to 10 to 15 years	10 to 15 years of wildlife habitat loss
1a				Reduce the loss of small nongame birds	unquantifiable
1b				Reduce the loss of 344 sagegrouse by 129	215 birds lost
1c				Reduce the loss of small nongame rodents	unquantifiable
1d				Reduce the loss of cottontail rabbits	unquantifiable
le				Reduce the loss of reptiles reptiles	unquantifiable

Table HS 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Fish and Wildlife (continued)					
WL-2	30 CFR 715.18(b)	N/A	Retention of four drainage control dams	Will enhance existing wildlife habitat and create habitat for waterfowl nesting which does not occur on the area at the present time	None
Cultural Resources					
CR-1	N/A	106 Compliance	N/A	Some cultural material could be lost since it would not be recognized	Loss of some cultural material
Visual Resources					
VR-1	30 CFR 715.13(a) 30 CFR 715.20(a) 30 CFR 715.14	N/A	Recontouring revegetation	Could be returned to existing visual class	None

Table HS 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Recreation Resources					
RE-1	N/A	N/A	N/A	There are no regulations or mitigation concerened primarily with recreation. However, if reclamation for wildlife species was successful, the hunting aspects of recreation should be improved.	All
Agriculture					
AG-1	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 & 211	Revise reclamation plan to provide for establishment of vegetative cover of native species in a timely manner	Reduce time of estabishment of vegetative cover of native species to 10 to 15 years	Loss of sheep range for a 10 to 15 year period
AG-1a				Reduce grazing loss from 13,061 AUMs to 5,200 AUMs	Loss of 5,200 AUMs of grazing
AG-2	30 CFR 715.18(b)	3041 & 211	Revise reclamation plan to provide for construction of permanent water impoundment or retention of drainage control dams with the approval of regulatory authority	No loss and possible enhancement of water facilities for livestock	None

Table HS 4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Mineral Resources					
MR-1	N/A	N/A	N/A	N/A	All
Land Use					
LU-1	N/A	N/A	N/A	N/A	All
Socioeconomics					
SE-1	N/A	N/A	N/A	N/A	All
SE-2	N/A	N/A	N/A	N/A	All
SE-3	N/A	N/A	N/A	N/A	All
SE-4	N/A	N/A	N/A	N/A	All
SE-5	N/A	N/A	N/A	N/A	All
SE-6	N/A	N/A	N/A	N/A	All
SE-7	N/A	N/A	N/A	N/A	All
SE-8	N/A	N/A	N/A	N/A	All
SE-9	N/A	N/A	N/A	N/A	All
SE-10	N/A	N/A	N/A	N/A	All
SE-11	N/A	N/A	N/A	N/A	All
SE-12	N/A	N/A	N/A	N/A	All

Table HS4-1 (Continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness Feasibility	Residual Impact
Socioeconomics (Continued)					
SE-13	N/A	Mine Health and Safety Act of 1969, as amended	N/A	N/A	Unquantifiable
SE-14	N/A	Mine Health and Safety Act of 1969, as amended	N/A	N/A	Unquantifiable

Table HS4-2

RECOMMENDED SEED MIXTURE

Species Name	Ratio of seeding
Rosana western wheatgrass	3 to 4 pounds PLS/acre
Sodar streambank wheatgrass	1 to 2 pounds PLS/acre
Indian ricegrass	1 to 2 pounds PLS/acre
Bluebunch wheatgrass	1 to 2 pounds PLS/acre
Critana thickspike wheatgrass	1 to 2 pounds PLS/acre
Sweetclover	0.5 to 1 pounds PLS/acre
Four-wing saltbush	2 to 3 pounds PLS/acre
Winterfat	1 to 2 pounds PLS/acre

Table HS4-3

SHRUB PLANTING DENSITIES

Plant Species	Level Areas	Aspect along terraces, contours, catchment Basins Special Areas *	North and East Slopes		
			Upper Third	Mid Third	Lower Third
Big Sagebrush	250**	350	250	300	400
Bitterbrush	200	150	200	150	---
Little Rabbitbrush	100	100	100	75	---

* Special areas may include constructed draws, swales, leeward side of snow catching structures

** Planting rate is number of potted shrubs per acre.

survival rate and increase growth vigor of the planted shrubs.

16. Shrub planting along contour furrows or contour terraces shall be of a width extending 1 foot above and 2 feet below the furrow or terrace.

17. All topsoil storage piles will be seeded with sodar streambank wheatgrass at the rate of 12 pounds pure live seed (PLS) per acre and a cover crop of fall rye (biennial plant) at a rate of 10 pounds PLS per acre.

18. All reclaimed areas will be fenced in a manner that would exclude livestock and pronghorn and not be a hazard to wildlife.

19. Where possible, all utility lines should be buried underground. This would significantly reduce vertical intrusions on the landscape.

20. All buildings, power line poles, conveyors, and any other type structures should be painted earth tone colors so they would blend into the landscape.

Discretionary Measures

1. On selected areas, in lieu of potted shrubs, plugs with native vegetation could be placed with a minimum spacing of 3 to 7 per acre. Plugs would be 5 feet by 5 feet in size with a minimum depth of 3 feet. Plugs will be removed from areas planned to be stripped of topsoil. All plugging will be done during the months of February through May. Other times and methods of planting may be done with prior approval of the managing agency.

2. All seed would be prilled to aid in seed distribution and germination.

3. All seed would be treated with a repellant to prevent seed damage by rodents or birds.

4. In areas where rodent populations inhibit reclamation efforts, control measures would be initated to control the rodent population.

IMPACTS

Topography

Impact TO-1; mining operations would change the existing topographic features and drainage patterns. SMCRA regulations 30 CFR 715.14 require that the area be returned to the approximate original contour. With a properly designed grading and backfilling plan this could be accomplished on the Hanna South site. If this was accomplished, there would be no residual impact.

Soils

Impact SO-2; loss of soil productivity on 809 acres would occur. SMCRA 30 CFR 715.16 requires that topsoil material be removed, stored, and redistributed on disturbed areas to retain soil productivity and enhance reclamation. With the application of SMCRA 30 CFR regulations, it is estimated that the potential soil productivity levels (post mining) would be equal to the premining levels. Soil productivity would be lost on the 809 acres during the time from disturbance until reclamation is successful. See Figure HS4-1.

Impact SO-3; increased soil loss would occur due to wind and water erosion on disturbed areas (809 acres). SMCRA 30 CFR 715.13, 715.14, 715.16, and 715.20 require that all disturbed areas be restored in a timely manner, conforming closely to original contour, with salvage of topsoil and establishment of a diverse and permanent vegetative cover of species native to the area. The application of SMCRA 30 CFR regulations would reduce the erosional rates on reclaimed areas by an estimated 75%. An estimated 25% of erosional losses would still occur.

Impact SO-5; increased wind and water erosion would occur on topsoil stockpiles and overburden spoil piles. SMCRA 30 CFR 715.14, 715.16(c), 715.16(a) require the topsoil piles be located as to minimize erosion. Measures to control erosion from overburden piles shall be specified by the regulatory authority. The application of SMCRA 30 CFR regulations would reduce erosion from topsoil storage areas by an estimated 75%. An estimated 25% of erosion would still occur. An indeterminate amount of erosion would occur off of overburden spoil piles.

Impact SO-6; toxic substances would contaminate soil profiles around mine facilities. SMCRA 30 CFR 715.14(j) requires all toxic or waste material be buried a minimum of 4 feet and/or treated to neutralize toxicity. The application of SMCRA 30 CFR regulations would control the impact 100%.

Impact SO-7; alteration of topography, slopes, and drainage patterns would result in increased water erosion. SMCRA 30 CFR 715.14 requires backfilling and grading conform as close as possible to original contour and grading be done on the contour. Rills and gullies 9 inches or less on reclaimed areas shall be regraded and stabilized. The application of SMCRA 30 CFR regulations would reduce erosion on reclaimed areas by an estimated 75%. An estimated 25% of erosional losses would still occur.

Impact SO-8; exposure of toxic material (overburden and/or soil) would hamper revegetation efforts. SMCRA 30 CFR 715.14(j) requires all toxic or waste material be buried a minimum of 4 feet and/or treated to neutralize toxicity. The application of SMCRA 30 CFR regulation as well separation and burial of unsuitable overburden and parting material beneath suitable overburden material would control the impact an estimated 100%.

Impact SO-9; a beneficial impact of the proposed action would be utilization of soil resource for a higher purpose (retention of four drainage control dams). Under SMCRA 30 CFR 715.18(b), retention of the dams would be compatible with post-mining land use. The application of SMCRA 30 CFR regulation would allow the utilization of soil resource for a higher use.

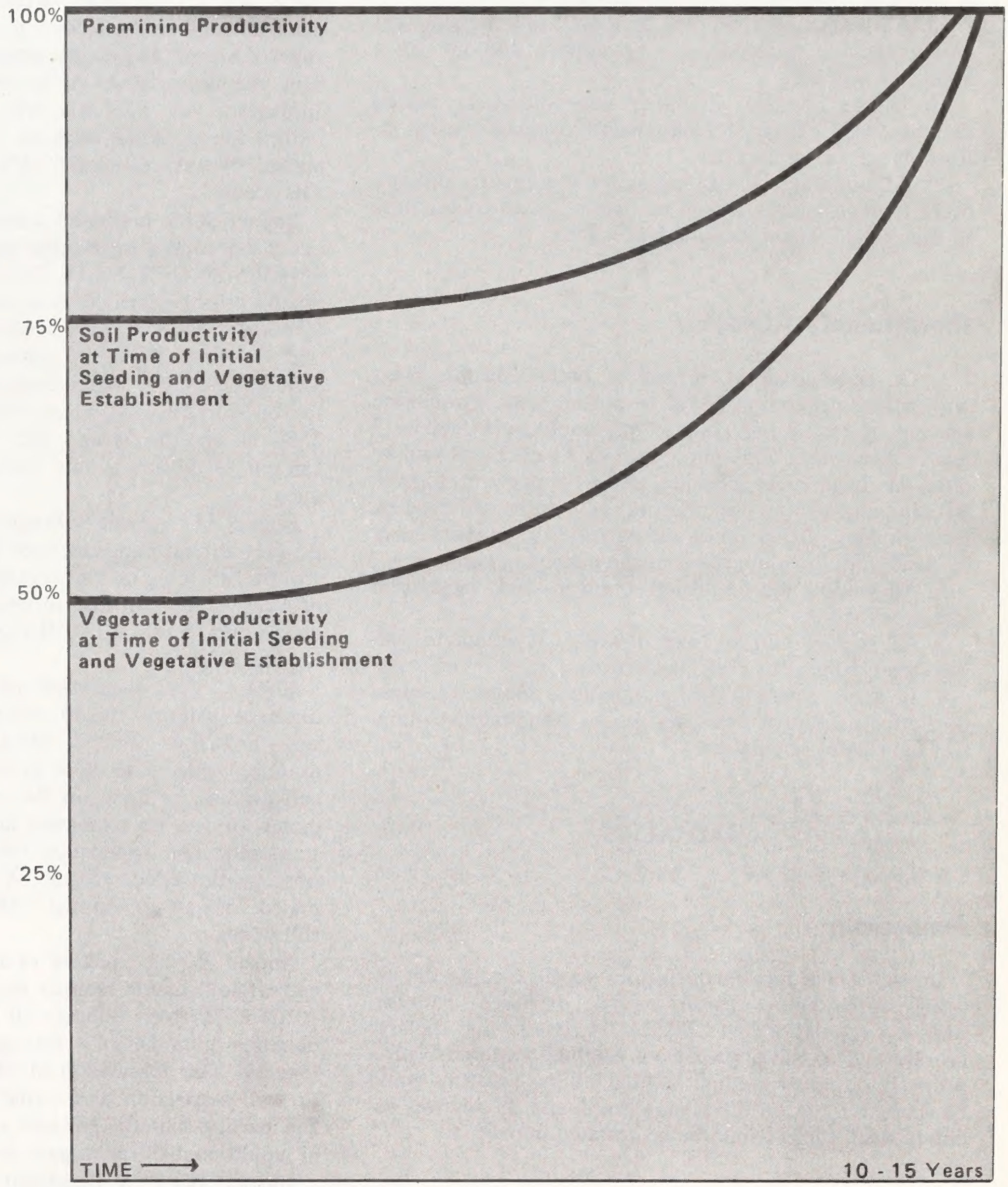


Figure HS 4-1

SOIL AND VEGETATIVE PRODUCTIVITY UNDER MEASURES REQUIRED TO MEET STANDARDS ESTABLISHED IN THE SURFACE MINING CONTROL AND RELAMATION ACT OF 1977

Hanna South

Water Resources

Impact WR-1; mining operations could lower the water level in a well adjacent to the project area. SMCRA regulations 30 CFR 715.17 require the hydrologic system be protected. Under this regulation if the well water supply were affected, it would have to be replaced, and there would be no residual impact.

Impact WR-2; mining operations would destroy an existing stockwater pond. SMCRA regulations require the hydrologic system be protected. Under this regulation, the pond would have to be rebuilt or replaced, and there would be no residual impact.

Vegetation

Impact VG-2; reclamation would result in conversion of vegetative type for a long-term (40 to 50 years) time period. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a) require the establishment on all lands that have been disturbed, a diverse, effective, and permanent vegetation of species native to the area and that restoration be in a timely manner. Under the proposed action, it is estimated that 40 to 50 years would be required to acquire a cover of native species since the proposed reclamation measures do not contain a species composition that would result in a vegetative cover similiar to premining vegetation. Proposed measures would not result in timely reclamation since natural succession would be relied upon to reestablish native vegetation. The process could require 40 to 50 years to accomplish. Through the application of the SMCRA regulations, the time periods for reclamation to vegetative cover of native species and composition could be reduced by 25 to 30 years. The residual impact would be the loss of native vegetative cover for a 10 to 15 year period.

Impact VG-3; grazing of young plants on reclaimed areas would delay establishment of vegetative cover during a 40 to 50 year period. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a) require that restoration be carried out in a manner that encourages a prompt vegetative cover and recovery of productivity levels in a timely manner. Under the proposed action, no provisions are made for control of the use of the reclaimed areas by either domestic stock or wildlife. Grazing use of the reclaimed areas would affect vigor of young plants and cause delay in establishment of adequate vegetative cover. With the application of SMCRA regulations, measures would have to be initiated to assure that vegetation could be established promptly without undue hinderances, which in turn would result in the recovery of productivity levels. The measures applied would apply solely to the control of grazing by livestock and pronghorn.

Impact VG-5; noxious weeds could invade onto disturbed and reclaimed areas. The State of Wyoming Noxious Weed Law requires that weeds identified by the state as being classified as noxious will be controlled. Under the proposed action, no provisions are made for compliance with this law. Revisions of the mining and reclamation plan are needed to include measures that would result in the control of noxious weeds. When the mitigation measures are applied as required by law full control of noxious weeds should be accomplished.

Impact VG-7; the vegetative productivity level on reclaimed lands is expected to be 495 pounds air dry vegetation per acre as compared to 650 pounds on premined acreage. SMCRA regulations require that revegetation shall be carried out in a manner that encourages the recovery of productivity levels in a timely manner. It is estimated that the soil and vegetative measures included in the proposed action are not stringent enough to establish the premining productivity level. Modification of the proposed measures to meet SMCRA standards would result in full recovery of premining productivity.

Fish and Wildlife

Impact WL-1; proposed reclamation would result in conversion of the present vegetative habitat for a period of 40 to 50 years. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(e) require the reestablishment of vegetation on disturbed areas in a timely manner, and species selected for reclamation shall be those that will fulfill the needs of native wildlife. Under the proposed mining and reclamation plan, it is estimated that 40 to 50 years would be required before a vegetative cover similar to premining vegetation would become established, since the proposed reclamation plan does not provide for shrub species to be reseeded that are native to the site. The proposed action would not result in reclamation to native shrub species and as a result natural succession would be required for 40 to 50 years. Through the application of SMCRA regulations, the period of time required for returning the vegetation to premining composition could be reduced by 30 to 35 years. The loss of wildlife habitat under these procedures would only be for 10 to 15 years as opposed to 40 to 50 years under the proposed action.

Impact WL-1a, 1b, 1c, 1d, and 1e would be indirectly reduced under the same time frame and SMCRA regulations as are noted above in the section on Impact WL-1. Loss of habitat and loss of animals are synonymous as far as reclamation and time are concerned.

Impact WL-2; the proposed action includes the construction of four drainage control dams. These dams would furnish or develop aquatic wildlife habitat where none exists in the premining habitat complex. SMCRA regulation 30 CFR 715.18(b) allows the land management agency to stipulate that the dams be retained and not destroyed. Waterfowl nesting habitat would then be created where none exists at the present time. Retention of the dams, then, would be an enhancement of habitat, not an adverse impact.

Cultural Resources

Impact CR-1; subsurface cultural material could be lost during mining since it might not be identified prior to surface disturbing activities.

The cooperative procedures between BLM and GS ("Cooperative procedures pertaining to the protection of cultural resources related to onshore mineral leasing operations exclusive of oil, gas, geothermal and oil shale") require that the Area Mining Supervisor, GS be contacted by the operator if any subsurface cultural resources are located during mining operations. The site will be evaluated and if determined to be of National Register quality compliance with Section 106/26 of the Historic Preservation Act of 1966 would be completed.

Visual Resources

Impact VR-1; although no portions of SMCRA apply directly to visual resources, if reclamation measures required for other resources are carried out, the visual quality will be improved to present premining levels.

Agriculture

Impact AG-1; suitability of range for sheep grazing on 809 acres would be lost for 40 to 50 years. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a) provide for establishment of vegetative cover of native species in a timely manner. Under the proposed action, the reclamation measures that would be applied would result in a vegetative cover that would be marginally suitable for sheep grazing. After primary reclamation efforts, natural succession would be the principal means for the establishment of additional native species that would return the area to a vegetative composition highly suitable to sheep grazing. The natural succession process is expected to take 40 to 50 years. With the application of SMCRA regulations, measures would have to be initiated that would enhance the establishement of shrub cover and to reduce the length of time required to establish a vegetative cover of desired species composition for sheep grazing. It is estimated that the reclamation time could be reduced by 25 to 30 years and residual of the impact would be loss of sheep range for 10 to 15 years.

Impact AG-1a; loss of 13,061 animal unit months (AUMs) of grazing would occur during mining and reclamation. Under the proposed action, the destruction of 809 acres and isolation of 1,991 acres of sheep range for the duration of the reclamation period required to restore suitable sheep range by natural succession (40 to 50 years) would result in a grazing loss of 13,061 AUMs. With the application of measures to meet SMCRA standards, suitable sheep range would be established 25 to 30 years sooner. The resulting loss of grazing would be confined to a 10 to 15 year period and would be approximately 5,200 AUMs.

Impact AG-2; destruction of one stockwater reservious would occur. SMCRA regulation 30 CFR 715.18(b)(8) permits the retention of structures such as drainage control dams with the approval of the regulatory authority. Due to the development under the proposed action, one stockwater pond would be destroyed or rendered useless. No provisions for replacement or restoration of this water facility are provided in the mining and reclamation plan. Application of SMCRA regulations and revision of the reclamation plan would provide for retention of the drainage control structures which would fully replace the loss of the one stockwater reservoir. Possible enhancements of the management of the range resource could result.

Socioeconomics

Impacts SE-13 and SE-14; work-related injuries and fatalities would occur. The Mine Health and Safety Act of 1969, as amended, regulates safety practices of coal mines. The number of injuries and illnesses that would occur even with the safety measures applied is not quantifiable. There is no mitigation for impacts SE-1 through SE-12.

MONITORING, RESEARCH, AND STUDY PROGRAMS

Prior to the beginning of mining, the company will provide for measurement of water levels and quality in all wells within 1 mile of the project boundary so as to provide baseline data against which changes can be measured. The company shall arrange for the same wells to be monitored for both water level and quality during the life of the mine so that changes can be documented. If water levels decline or water quality deteriorates as a result of mining, the company shall either provide a replacement source of water or renumerate the owner for damages and shall modify their operation to stop the decline or quality deterioration. The mine company shall provide for monitoring quality of any water leaving the project area to insure that SMCRA requirements are met.

A representative of BLM will annually inspect livestock grazing areas adjacent to mining operations to determine if such operations are affecting grazing patterns of the allotment, to determine if any range overuse is resulting from the changes in grazing patterns that may be occurring, and to determine measures to be applied to correct the overuse of the range.

As reclamation is accomplished, the compliance officer (state and federal) would conduct periodic inspections of mining areas to assure that reclamation is accomplished in accordance with an approved reclamation plan.

Reclaimed areas would be jointly inspected periodically by representatives of federal and state agencies and the operator to determine areas on which reclamation is completed and acceptable and to jointly determine corrective measures to be applied on areas where reclamation efforts have proven inadequate (e.g., seeding failure).

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

There will be no additional mitigating measures to reduce the air quality impacts. Therefore the annual emissions from the Hanna South Mine are expected to be shown in Table HS3-5. Of the total annual TSP emmissions of 1,375; 1,263; and 805 tons/year generated at the mine for the years 1980, 1985, and 1988 respectively, only about 2% would be applicable to the new interim regulations implemented by the EPA (43 CFR 118). The other 98% would be fugitive dusts and would be excluded from any air quality assessment. The Hanna South Mine would not be expected to exceed the NAAQS, nor the Class II increment under the new review procedure. However, fugitive dusts, to be controlled using best management practices, would still be the most significant air quality impacts resulting from strip mining.

During the active life of the Hanna South Mine, particulate air quality at the mine site and some closely surrounding areas including the town of Hanna would be degraded to some extent. However, upon completion of mining activities and successful reclamation, the air quality would return to the premining level.

Visibility would be expected to average 26 to 47 miles depending upon climatological conditions. During worst case fugitive dust conditions visibility may be expected to decrease to about 10 miles however, this occurrence would be infrequent.

Unstable backfilled areas could be unsuitable for housing or other development.

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur due to the mining process and unauthorized collecting.

The destruction of natural features of the landscape would be unavoidable. Immediately after restoration, the average elevation of the strip-mined area should be about the same as present, because the expansion of the overburden would tend to compensate for the removal of the coal seam. However, the mined area would partially recompact over many years, eventually lowering the average elevation by about 20 feet.

The mine would increase municipal and industrial water use in the ES region by 100 acre feet per year or 0.4%. The aquifers around the mine could be dewatered, thus causing water levels to drop in one stockwater well until about 1996. The well is on private land and is not being used at present.

Disturbance of existing soils on a total 884 acres could not be avoided. Soil productivity would be lost on 152 acres by disturbance from mine facilities, ancillary facilities, and urban development. Productivity on 120 acres of this 152 would be permanently lost due to urban development and retention of four drainage control dams.

In the area to be disturbed, soil profiles, properties, and characteristics that have developed over geologic time would be destroyed on 809 acres. The existing soil biota and soil forming process would be drastically altered. Surface mining would destroy approximately 85 acres a year with a maximum of approximately 210 acres of soils exposed at any one time.

The estimated potential soil productivity levels of reclaimed areas would be about 100% of the premining levels. However, soil productivity would be lost during the time of disturbance (10 to 15 years after reclamation).

An estimated 25% of erosional losses, both wind and water, on all disturbed areas would not be controlled with watering and chemical stabilization, haul road fugitive dust levels would be reduced 50%. There would be a soil loss of about 0.42 ton/acre/year due to wind erosion off of overburden spoil piles.

The development of the Hanna South project would result in the destruction of 809 acres of native vegetation on the project area and 75 acres for housing and support service sites at various population centers. Of this total (884 acres), native vegetative cover would be lost permanently on 120 acres; 75 acres utilized for housing, etc., and 45 acres for the drainage control dams that could be retained. Although a vegetative cover of native species would be restored on the remaining 764 acres, the loss of vegetative cover in varying degrees would be sustained for a period of 10 to 15 years which is the period considered necessary for full vegetative cover establishment and recovery of productivity.

Since the control of haul road dust and fugitive coal dust would be approximately 50% effective (projected), the palatability of vegetation adjacent to the disturbed areas would be affected for a 10 year period while mining operations were being conducted.

It is anticipated that 809 acres of wildlife habitat would be destroyed by surface mining and construction of ancillary facilities. In spite of provisions for reclamation of this acreage, it would be lost as wildlife habitat until the end of mine life. In addition to the acreage that is disturbed, there would be 1,991 acres within the project boundary lost to wildlife during the mine life because of mine related activities. These losses could not be avoided. There would be minimal use of the reclaimed areas, that were seeded to grass, by pronghorns and mule deer in the early spring. Sagebrush and greasewood that could provide suitable wildlife habitat for all species

would not become reestablished through natural succession for 40 to 50 years after reclamation was initiated.

The loss of habitat due to the project would not result in any significant reduction in either the pronghorn or mule deer populations since so few of these animals occur on the project area. Surrounding habitat could absorb the displaced animals with no detrimental effects to the local populations. .

Losses of sage grouse would be more significant. An estimated 86 sage grouse would be lost to all users over the period of mine life. These losses would be unavoidable.

There would be no losses occurring to raptors since there are no known nesting sites on the project area.

It is anticipated that the increase in human population due to increased employment in the project area would also increase losses from poaching, wanton destruction, harrassment, and animal/vehicle collisions. These losses also could not be avoided.

The effective mitigation of adverse impacts to subsurface cultural resources would depend upon several factors. These factors include; (1) successfully predicting areas of likely subsurface sites, (2) the amount of destruction which occurred to a site as it was being unearthed, and (3) the ability and willingness of workers to recognize and report cultural resources when they are discovered in the absence of a professional archeologist.

The proposed coal mining would lower the scenic quality of the landscape character of the Hanna South project area. During mining the area would be lowered from Visual Resource Management (VRM) Class III to Class V. Spoil piles, pit headwalls, coal storage, and topsoil piles would permanently alter the landscape character. Roads, power lines, phone lines, and other structures would remain until removed and the site is revegetated. The changes to line, form, color, and texture would be obviously visible until vegetation is successfully reestablished. At that time, the area could be returned to a Class III.

Recreational access would be restricted during mining in the Hanna South project area. As the mine was developed, people would come to the area to view the mining activities. Those activities which would be affected by the access restrictions on site would be hunting, sightseeing, and off-road vehicle travel.

Increased population would result in increased recreational use throughout the southcentral Wyoming region. This increase use would result in lowering the quality of the existing type of outdoor recreational experience. Also, due to increased use, ranchers in the area could restrict access across their private lands. The urban recreation facilities in Hanna, Saratoga, and Rawlins would experience the largest increase in use.

Table HS3-10 depicts estimated visitor use change due to the proposed coal mining. The numbers illustrate the changes in recreation use due to population increases in the region.

The destruction of vegetation and the isolation of undisturbed vegetation through the development of the Hanna South project would result in an unavoidable loss of grazing on the Dana Meadows South grazing allotment. This grazing loss would be extended over a 10 to 15 year period during which vegetative cover suitable as sheep range would be restored. Once restored, the reclaimed areas and the isolated areas would be returned to use. The grazing loss sustained during this 10 to 15 year period would be approximately 5,200 animal unit months.

The removal of 6.1 million tons of coal for power generation would reduce Wyoming's coal reserves by about 0.02%. Dilution, caused by use of large equipment for rapid removal of overburden and coal, would result in the loss of an additional 1.2 million tons.

The estimated 1,500 cubic yards of sand and gravel needed for construction of mine facilities would not be recoverable at the end of mining operations.

The 77,400 cubic yards of scoria (clinker) needed for road construction would not be recoverable at the end of mining operations.

Mining would occur within the scenic corridors along U.S. Highway 30 and State Highway 72.

The Hanna South project would cause a shortage of 67 workers in other sectors of the economy by 1980. The Hanna South project would increase total wage earnings $6.9 million in the region, creating local inflationary pressures, and reducing the buying power of people on fixed incomes.

This same inflationary trend would force the price of housing higher, creating crowded housing conditions and forcing people to accept housing that is not up to their expectations or desires.

By 1990, the Hanna South project would lead to a need for one additional registered nurse.

Congestion on local access roads would increase, especially during shift changes. Traffic delay would increase 8 minutes a week at railroad crossings along the route from the Hanna South project to markets. Although not quantifiable, the coal trains would increase noise and air pollution along the route.

CHAPTER 6

SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

Approval of this mining and reclamation plan would allow mining of 6.1 million tons of coal over a period of 10 years to meet national energy demands outside this region. The Hanna South Mine would be an expansion of the existing mines presently located in the immediate area. The present uses on the proposed mine site are livestock grazing and wildlife habitat. The area could be returned to premining land use after reclamation of the site.

The short-term use of the mine site would expose or disturb about 809 acres of land surface over the life of the mine. The air pollution caused by mining operation during coal extraction would be a short-term event which would cease at the end of the mine life. The largest potential threat to long-term productivity in terms of air quality would be the failure of complete reclamation of the exposed and disturbed acreage. Wind erosion could continue to generate fugitive dust emissions from the mine site if a proper vegetative cover were not established. If however, land reclamation were successful, no long-term problems from wind erosion would be expected. Since the land would be returned to grazing the long-term effects of mining should be nonexistent.

The major portion of the particulate air quality impact from the Hanna South Mine site would take place to the north and east of the mine site on an annual and 24-hour worst case basis. On an annual basis, measurable impact (10 $\mu g/m^3$ micrograms per cubic meter) would not extend more than 1 mile west of the mine site. In a 24-hour worst case, measurable impact would not be detectable beyond 2 miles west of the mine border. The Seminoe I Mine is located over 3.5 miles east of the Hanna South Mine site. Therefore no interaction or cumulative effects are predicted between these two mines.

The Seminoe II mine is located about 1.6 miles north of the Hanna South Mine site. Annual concentrations of 10 $\mu g/m^3$ and 20 $\mu g/m^3$ 24-hour worst case are predicted as far as 1.9 miles north of the Hanna South Mine site as a result of mining activities at said mine. This would in all likelihood cause a short-term cumulative effect at the southern reaches of the Seminoe II Mine site. No long-term effects are expected since air qulaity would return to premining levels at the end of the mining activities.

Since prevailing winds are from the south and west, no cumulative effects are predicted at the Hanna South site as a result of mining activities at the Seminoe II site. Water used by the mine and municipalities as a result of the mine would not be available for other uses during the life of the mine, but would become available immediately after completion of mining.

It would require about 8 years after mining was completed to recharge the aquifers dewatered by mining, but there would be no long-term affect on productivity in relation to water resources.

Long-term and short-term productivity would be disrupted by the proposed Hanna South project. Short-term use of the soil resource resulting from construction of mine facilites, ancillary facilites, and mining operations (final contour) would disrupt the productivity levels and increase soil erosion losses on 809 acres. Potential soil productivity levels would be restored to an estimated 100% of premining potentials on 764 acres with successful reclamation. The retention of the four drainage control dams would remove 45 acres for an alternate use.

For the long term the vegetative productivity of the disturbed area would be lowered by approximately 25% of the premining productivity due to characteristic of the replaced soil. The long-term productivity of the reestablished vegetation would be an adequate level to permit use as livestock range within a 4 to 5 year period after initial reclamation. The suitability of the reclaimed areas as wildlife habitat would be delayed for approximately 40 to 50 years during which time natural succession would increase the shrub component of the vegetation. The length of this time period could be shortened with application of additional reclamation measures as outlined in the reclamation alternative, Chapter 8. In the short term, total production would be lost on 809 acres disturbed in the development of the mine and construction of mine and ancillary facilities. Reclamation of 764 acres of the disturbed land on the project would result, with time, in the establishment of a suitable vegetative cover and the restoration of the former use of the land.

In the short term there would be:

1. Loss of all wildlife habitat (809 acres) inside the final contour, plus habitat located within the project area not disturbed, but rendered unavailable (1,992 acres) by mine related activities.
2. The loss of an estimated 86 sage grouse.
3. Heavy losses, that are not quantifiable, of small rodents, cottontail rabbits, small songbirds, mourning doves, and reptiles over the 809 acres.
4. Displacement of an estimated 20 pronghorns into adjacent areas.
5. Displacement of an estimated five mule deer into adjacent areas.

SHORT TERM VS. LONG TERM

In the long term, a vegetative complex similar to premining habitat would be attained and would be capable of supporting premining populations of wildlife after 10 to 15 years of reclamation.

A long-term commitment of cultural resources would result from the destruction of sites. If all sites were left in situ, more information could possibly be extracted from the site by improved techniques in the future. Due to proposed mining at Hanna South, the intensive cultural inventory for this area has been greatly accelerated.

Short-term improvements to Class V areas could be achieved when mined areas are reclaimed. Long-term improvement would be achieved by revegetation, natural plant succession, removal of mine equipment and power lines, and restoration of waste disposal areas.

The short-term loss of production caused by disturbance of 809 acres by project development and by isolation of an additional 1,991 acres by mining activities would result in a permanent loss of 2,169 animal unit months of grazing on the Dana Meadows South grazing allotment. Even though the production potential of the reclaimed acreage would be 25% less than premining production level, adequate forage would be available in the long term to permit livestock grazing at the level authorized prior to disturbance.

Development of the proposed mine would change the nature of the primary recreational activity (hunting) since most of the reclaimed areas would not be suitable for wildlife habitat for a long period of time. As human activity increases at the mine, disturbance to all recreation activities would occur in the short term owing to the loss of the recreation land base. In the long term, recreation use on the area could resume with removal of mining equipment, successful reclamation, and reestablishment of wildlife plant species.

A short-term trend would be the tendency for recreational vistors to go elsewhere in the region, thus impacting other areas. This trend could reverse in the long term.

The major trade-off in mineral resources would be between the short-term use of the coal, sand, gravel, scoria, oil, and diesel fuel and the long-term availability of these resources.

In the short-term, the increased employment at the Hanna South project would create labor shortages in othe regionalr sectors of the economy. In the long term, as more people move into the region, a labor force of sufficient size to meet the needs of all employers would be available. In addition, this increased employment would tend to hold the unemployment rate at its current low level.

Increased wage earnings would in turn increase retail and wholesale trade over the life of the mine. This would be a short-term gain while the loss of buying power of people on fixed incomes would be long term.

In the short term, housing prices would rise and crowded conditions would occur. However, over the long term the housing stock would increase, allowing such crowded conditions to subside.

Health care in this region may never be considered up to standard, but over the long term the population/health care specialist ratios would return to at lease the current levels. Impacts directly associated with mining of coal (congestion on access roads, traffic delay railroad crossings, air and noise pollution) would be short term in nature and would disappear when the mining ceases at the project.

Work-related injuries and illness would be short-term losses due to the proposed action. Those injuries or illnesses which are fatal or debilitating would reduce long-term human productivity.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Implementation of the project would result in commitments to use the area more intensively and would significantly alter the use of various resources. The use and consumption of land and resources would be irreversible (once initiated, use and impacts would continue and could not be reversed for a long time, if at all) or irretrievable (irrecoverable for a long period of time or permanently). Irreversible refers to trends; irretrievable refers to loss of resources for other uses. Some commitments are both irreversible and irretrievable.

Soils, vegetation, wildlife, and present land uses on the proposed project area would be irreversibly committed during the life of the project and thereafter until reclaimed or reestablished. Air and water would be irreversibly committed during the life of the project to the extent that air quality would be degraded and water used by the project would not be available for other uses. A major irretrievable commitment would be the removal of 6.1 million tons of coal, which would be permanently lost, and therefore, not available to future generations. Cultural values, construction materials, fuels, and any loss of human life would also be irretrievable if the project should be implemented.

This chapter summarizes and quantifies where possible these, types of resource commitments for the entire project to provide a total picture of what implementation of the project would involve.

An irretrievable commitment of an undetermined number of uninventoried, exposed and unexposed fossil localities would result from mining as well as an increase in unauthorized fossil collecting. The destruction resulting to the resources would be an irretrievable commitment.

The loss of native vegetation and associated productivity on the 45 acres used in the retained drainage control dams and 75 acres utilized in housing and support service site would be an irreversible and irretrievable loss to the range resource.

The destruction of existing soil profiles and loss of soil by erosion (unquantifiable) occurring on 884 acres would be an irretrievable loss. The soil productivity lost on 45 acres drainage control dams and 75 acres (population needs) would be irretrievable since the soil resource would be used for an alternate use.

It is anticipated that some wildlife species would be significantly reduced from present population levels. Based upon this, about 344 sage grouse would be irretrievably lost over the long term. Other species of wildlife such as small mammals and nongame birds would also be lost, but numbers cannot be quantified due to a lack of baseline population data. Raptor hunting habitat would also be lost over the long term, but this cannot be quantified with present data.

The destruction of sites would be an irreversible and irretrievable commitment of the resource.

Because of soil variations, slopes, and climate, vegetative reclamation scars on the landscape would be evident. However, the area could be returned to a Class III.

The coal related population increases would impact recreational activities (especially urban). Although some of the coal related population would leave once mining was completed, the regional population increase would cause an irreversible impact on recreation resources.

The major irretrievable commitment of resources would be 7.3 million tons of coal produced or lost during the 10-year life of the mine. Of this total, 6.1 million tons would be mined by 1988 which is the projected end of mine life. The remaining 1.2 million tons would be left in place since they would not be recoverable by the proposed mining techniques.

The 78,900 cubic yards of sand, gravel, scoria, and other types of aggregate material used in construction of housing, roads, and mine facility construction would, for all practical purposes, be irretrievable because replacement under prevailing conditions may take centuries. Transportation of the coal resource would require an estimated 34,668 gallons of diesel fuel per year which would come from domestic or imported oil sources. An additional indeterminate amount of diesel fuel would be required to transport the coal from the regional boundary to the markets.

The Hanna South project would irreversibly reduce the buying power of people on fixed incomes. The buying power they lose during times of inflation would never be regained.

Fatal or debilitating injuries and illnesses would be an irreplaceable loss of the human resource.

Community expansion would lead to an irreversible change in land use from rangeland to residential around and near those communities receiving additional population from this mine.

CHAPTER 8

ALTERNATIVES

The Geological Survey (GS) has accepted the Hanna South Mining and Reclamation Plan as adequate for environmental review and consideration for subsequent approval under 30 CFR 211 regulations as of May, 1976. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing law and regulations. He may also defer decision pending submission of additional data, completion of required studies or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary. The regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate, new, improved, or revised administrative requirements, technologic improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO-ACTION ALTERNATIVE

No action on mining proposals for the initial development of existing federal leases would result in maintaining the status quo on those leases. Without the approval, the mining of federal coal, although under lease, would not be permitted and the Hanna South project would be abandoned since it would not be economically feasible to operate the mine without the inclusion of federally owned coal.

It is assumed that the coal from the Hanna South project would be shipped to Midwest utilities (6.1 million tons at a rate of 610,000 tons per year). If this coal is not mined, the anticipated Midwest markets would have to find an alternate source of low sulfur coal.

If the Hanna South project area is not mined, impacts as projected in Chapters 3, 5, 6, and 7 would not occur.

Population declines lead to many adverse effects such as excessive housing vacancies, community facilities (which are greatly over capacity), excessive private investment (in businesses which can no longer remain solvent, in homes which may decline in value, etc.) and higher taxes to pay for more facilities than are needed. It appears inevitable that such effects would eventually occur (the available coal would eventually be exhausted), but these effects would not occur prior to 1990 and would not be "triggered"by rejection of the mining plan.

DEFER ACTION

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan to provide for changes which reduce impacts or provide for acquisition of additional data and further evaluations.

Changes or mitigation beyond those already discussed in Chapter 4 which would further reduce impacts are identified in the fish and wildlife alternative, visual resource alternative, and the alternative addressing air quality impacts.

Action could be deferred until the company demonstrates in their present Hanna Basin Operations that reclamation on mined areas can be accomplished to meet the standards outlined in the Surface Mining Control and Reclamation Act. It is estimated that a judgement on initial reclamation success could be made in 3 to 5 years. However, reclamation efforts would be monitored by the authorized agencies and the determination would be made based on actual findings.

The submitted mine plan contains insufficient hydrologic data to permit an analysis of the quantity of groundwater that the proposed mine would intercept and the effect this would have on nearby wells. Mine plan approval could be deferred until the additional data have been provided and evaluated.

Delaying approval of the proposed mine and reclamation plan would result in impacts to the coal market area, i.e., an alternate source would have to be acquired as discussed under the No Action Alternative.

This mine is presently scheduled to begin operation in 1979. Assuming a 5 year delay, the mine would begin operation in 1984, the same year the proposed Cherokee Mine is scheduled to begin operations. Two principal impacts could result. First, there would be an increased competition for labor which could result in a shortage. Secondly, Rawlins would receive most of the population growth from both of these mines and the delay would compound the impacts on community services. The proposed uranium development described in Regional Chapter 1 would further compound these impacts.

PREVENT DEVELOPMENT ON THE

LEASE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different designed course of action by the lessee (operator). This may be accomplished by suspension of operation (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. Any of these would have the effect of precluding development.

If prevention of development of the existing lease were accomplished, substantial quantities of coal known to be present would be left in place and not recovered for use. To replace the resource foregone by this alternative course of action, other comparable quantities of coal would be required to substitute in the marketplace for this supply. Other impacts are described under the No Action Alternative.

APPROVE THIS MINING PLAN AFTER MODIFICATION

Best Management Practice Air Quality Alternative

A number of the impacts identified and described in Chapter 3 of this statement could be more fully mitigated by implementation of one or more of the alternatives described below. They follow the best management practices recommended by the Environmental Protection Agency in comments provided on the Southwestern Wyoming Regional Coal ES. The measures to reduce impacts are analyzed here as an alternative, but will probably be adopted as required measures in the final environmental statement and the impact analysis modified accordingly.

Haul roads would be the largest single source of fugitive dust emissions at the proposed Hanna South Mine site; contributing about 75% of the total annual emissions. The use of 100 ton haul trucks (as opposed to 23 ton, as now proposed) would reduce the amount of vehicle miles traveled and thus the amount of emissions. In addition, chemically stabilizing the haul roads would effectively control a significant portion of the fugitive dust generated by haul trucks. Chemical stabilization of the haul roads will generally control 50% to 75% of haul road emissions.

Since it is only 0.2 miles long, the access road would not be a major contributor to the annual emissions from the mine site. However, paving the access road would help alleviate some of the air quality impact. Paving the access road would be 85% effective in controlling emissions.

Controlling fugitive dust emissions from the coal stacker and storage pile would help alleviate some air quality impact, particularly in and near the town of Hanna since the coal storage pile would be quite close to the town. A foam which would be applied at the stacker would be about 85% to 90% effective in controlling emissions from stacking and storage.

Table HS8-1 shows the total annual emissions for each study year as presented in Chapter 3, the total reduction in emissions that would result from the above alternatives, the total annual emissions expected if the above alternatives are employed, and the percent change from the Chapter 3 emissions. Average control efficiencies of 62.5% and 87.5% were used for chemical stabilization and foaming respectively when making calculations.

A 45% to 50% reduction in annual TSP emissions would result in a significant decrease in air quality impacts. Isopleth maps showing the annual and 24-hour worst case predicted and resulting ambient concentrations that would be expected for each study year if the alternatives were employed are available for review at the Rawlins District Office of the BLM (PEDCo 1978).

The use of the alternatives would have no effect on gaseous emissions from mine vehicles. However, present levels of these pollutants are far below the standards and only insignificant amounts of these pollutants would be released from vehicles at the mine site.

Visibility at the mine site and near the access road would be improved by the reduction in fugitive dust. Visibility during the worst 24-hour case is not expected to fall below 17 miles near the mine site as opposed to 10 miles as predicted without the alternatives (Chapter 3). For the most part, visibility would be expected to average 26 to 47 miles depending on climatological conditions such as fog, rain, and snow.

WILDLIFE MITIGATION ALTERNATIVE

The recommendations listed in this alternative, if implemented, could significantly reduce the major impacts to the existing wildlife populations occurring on the Hanna South site.

Environmental Recommendations

1. All disturbed areas scheduled to be reclaimed should include the following browse species in the seeding mix; winterfat, fourwing saltbush, and little rabbitbrush. Seeding rates of these species should follow recommendations in Plummer et al. 1968.
2. Potted shrubs should be established in clusters behind snow fences so that protection and additional moisture afforded by the snow would increase the likelihood of shrub cover being quickly established.
3. That mine permits will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department,

Table HS 8-1

TOTAL ANNUAL EMMISSIONS FOR EACH STUDY YEAR
IF THE LISTED ALTERNATIVES WERE UTILIZED

Study Year	Annual TSP Emissions Without Alternatives (tons/year)	Annual TSP Emissions With Alternatives (tons/year)	Emissions Reductions (tons/year)	Emissions Reductions (%)
1980	1,375	666	709	52
1985	1,263	655	608	48
1988	805	443	362	45

and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for substitute mining practices, buffer zones, prey base, and alternate nest sites.

RESTRICT DEVELOPMENT ON THE LEASE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc.

Depending upon the extent to which development is restricted, the impacts would be similar to those described for the No-Action Alternative.

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decisionmaker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects on vegetation, soils, wildlife, etc., by reducing the area in which the impacting activities could take place. However, implementation of this alternative would not permit maximum recovery of the coal resources.

CHAPTER 9

CONSULTATION AND COORDINATION

See the Regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in preparation of the draft ES.

HANNA SOUTH APPENDIX

SOIL MAPPING UNITS

210—Ravalli-Forelle-15 complex, 0% to 6% slopes

These nearly level and gently sloping soils are on alluvial fans, terraces, and drainageways. The Ravalli soil makes up about 30% of the mapping unit, the Forelle soil about 30% and the 15 soil about 25%. The Ravalli soil differs from the Forelle and 15 soils by having a higher sodium content in the subsoil. The Forelle soil differs from the 15 soil by having a distinct clay accumulation in the subsoil. About 15% of the unit is Bullock and Rock River soils.

The Ravalli series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is yellowish brown, mildly alkaline sandy loam about 2 inches thick. The upper part of the subsoil is yellowish brown, moderately alkaline loam about 3 inches thick. The center part of the subsoil is brown, moderately alkaline loam about 9 inches thick. The lower part of the subsoil is very pale brown, very strongly alkaline clay loam about 6 inches thick. The upper part of the substratum is pale brown, very strongly alkaline loam about 5 inches thick. The lower part of the substratum is. pale brown, very strongly alkaline very fine sandy loam to 60 inches or more

The Forelle series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is grayish brown, mildly alkaline loam about 4 inches thick. The upper part of the subsoil is yellowish brown, mildly alkaline clay loam about 11 inches thick. The center part of the subsoil is yellowish brown, mildly alkaline clay loam about 14 inches thick. The lower part of the subsoil is pale brown, moderately alkaline clay loam about 16 inches thick. The substratum is pale brown, moderately alkaline loam extending to 60 inches or more.

The 15 series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is pale brown, moderately alkaline loam about 2 inches thick. The subsoil is light yellowish brown, moderately alkaline loam about 6 inches thick. The upper part of the substratum is pale brown, moderately alkaline loam about 37 inches thick. The lower part of the substratum is brown, moderately alkaline sandy loam to a depth of 60 inches or more.

251-Grieves-Blackhall association 2% to 20% slopes

This association consists of sloping to moderately steep upper slopes and ridge crests. Grieves sandy loam makes up about 55% of the mapping unit and Blackhall sandy loam makes up about 30%. Grieves soils occur on alluvial fans and gently sloping uplands. Blackhall soils occur on sloping to moderately steep upper slopes and ridge crests. Included in this unit are areas of Carmody soils and rock outcrop. These inclusions make up about 15% of the total acreage.

The Grieves soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 5 inches thick. The subsurface layer is brown sandy loam about 6 inches thick. The substratum is pale brown sandy loam to a depth of 60 inches.

The Blackhall soil is a shallow, well drained, soil forming over soft sandstone residuum. Typically, the surface layer is brown sandy loam about 2 inches thick. The substratum is light yellowish brown sandy loam to a depth of 17 inches. Soft, pale yellow, calcareous sandstone occurs at 17 inches.

252-Shinbara-Blazon-Rock Outcrop complex, 6% to 30% slopes

These sloping to steep soils are on bedrock controlled uplands. The Shinbara soil makes up about 35% of the mapping unit, the Blazon soil about 30% and Rock outcrops about 25%. The Shinbara soils differ from the Blazon soils by being shallower to bedrock. About 10% of the unit is Delphill and Tasselman soils.

The Shinbara series is a very shallow, excessively drained soil. It formed in very shallow loamy deposits weathered from shale interbedded with sandstone. Typically the surface layer is brown, strongly alkaline loam about 3 inches thick. The substratum is strongly alkaline silty clay loam about 3 inches thick. Soft fractured shale and coal occurs at 6 inches.

The Blazon series is a shallow, well drained soil. It formed in shallow loamy deposits weathered from interbedded sandstone and shale. Typically, the surface layer is brown, moderately alkaline clay loam about 5 inches thick. The substratum is pale brown, moderately alkaline clay loam about 11 inches thick. Interbedded sandstone and shale deposits occur at 16 inches.

253-Blazon-Satanka association 2% to 15% slopes

This association consists of gently sloping to moderately steep residual uplands. Blazon loam makes up about 40% of the mapping unit and Satanka sandy loam makes up about 35%. Blazon soils occur on ridge crests and upper slope areas. Satanka soils occur on concave midslope and lower slope areas. Included in this unit are areas of Delphill and Shinbara soils and rock outcrop. These inclusions make up about 15% of the total acreage.

The Satanka soil is a moderately deep, well drained, soil forming over interbedded sandstone, siltstone, and shale residuum. Typically, the surface layer is brown sandy loam about 3 inches thick. The upper part of the subsoil is brown sandy clay loam about 7 inches thick. The lower part of the subsoil is pale brown loam about 3 inches thick. The upper part of the substratum is very pale brown loam about 14 inches thick. The lower part of the substratum is gray silty clay about 8 inches thick. Soft, calcareous, interbedded sandstone, siltstone, and shale occurs at 35 inches.

254-Bullock-Blazon complex, 0% to 6% slopes

These nearly level and gently sloping soils are adjacent to upland drainageways. The Bullock soil makes up about 45% of the mapping unit and the Blazon soil about 35%. The Bullock soil differs from the Blazon soil by being deeper to bedrock and having distinct structure in the subsoil. About 20% of the unit is Ravalli and 15 soils. The Bullock series is a moderately deep, well drained soil. It formed in loamy deposits weathered from shale interbedded with sandstone.

Typically, the surface layer is light gray, moderately alkaline sandy loam about 3 inches thick. The upper subsoil is yellowish brown, moderately strongly alkaline silty clay about 13 inches thick. The substratum is dark grayish brown, moderately alkaline silty clay about 6 inches thick. Soft shale and coal occurs at about 32 inches.

257-Havre and Glendive soils 0% to 3% slopes

This undifferentiated unit consists of soils in narrow flooding drainageways. Each component of this mapping unit may occur in each delineated area, or they may occur separately. Included in this unit are areas of 15 soils. The inclusions make up about 15% of the total acreage.

The Havre soil is a deep, well drained, soil forming in stratified alluvium. Typically, the surface layer is grayish brown loam about 3 inches thick. The substratum is brown, silty clay loam to a depth of 60 inches.

The Glendive soil is a deep, well drained, soil forming in stratified alluvium. Typically, the surface layer is brown fine sandy loam about 4 inches thick. The substratum is pale brown fine sandy loam to a depth of 60 inches.

258-Rock River-Satanka association 0% to 12%

This association consists of level to sloping alluvial fans and adjacent uplands. Rock River sandy loam makes up about 45% of the mapping unit and Satanka sandy loam makes up about 35%. Rock River soils occur on alluvial fans and narrow drainages. Satanka soils occur on the sloping ridges and concave upperslopes. Included in this unit are areas of Blazon and Blackhall soils and rock outcrop. These inclusions make up about 20% of the total acreage.

The Rock River soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 2 inches thick. The subsoil is brown sandy clay loam about 10 inches thick. The substratum is calcareous, yellowish brown sandy loam to a depth of 60 inches.

260-Ryan Park-Rock River association 2% to 20% slopes

This mapping unit consists of gently sloping to moderately steep alluvial fans. Ryan Park sandy loam makes up about 45% of the mapping unit and Rock River sandy loam makes up about 30%. Ryan Park soils occur on the middle and upper portions of alluvial fans. Rock River soils occur on the lower portions of alluvial fans and alluvial bottoms. Included in this unit are areas of Grieves and Blackhall soils. These inclusions make up about 25% of the total acreage.

The Ryan Park soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 1 inch thick. The subsoil is yellowish brown sandy loam about 16 inches thick. The upper part of the substratum is pale brown sandy loam about 25 inches thick. The lower part of the substratum is yellowish brown sandy loam to a depth of 60 inches.

HANNA SOUTH APPENDIX

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROTTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES)[3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH) 6	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNNOFF[10]
Blackhall	10-20	Well to excessively drained	Very low 1.2-1.8	D	350-700	7.8-8.6	< 2.0	Low	3	Medium to Rapid
Blazon	10-20	Well drained	Very Low to Low 2.7-3.1	D	500-1000	7.9-9.0	2.0-4.0	Low	4L	Rapid
Bullock	20-26	Well drained	Very Low to Low 2.14-3.52	D	420-720	6.6-9.0	<2.0-8.0	Low	6, 3	Slow
Forelle	>60	Well drained	High 9.25-11.75	B	500-1000	7.0-8.8	<2.0	High	5	Slow
Glendive	>60	Well drained	High 8.4-10.24	B	900-1800	6.6-9.0	2.0-8.0	Moderate	5	Slow
Grieves	>40	Well drained	Moderately High 7.2-8.4	B	700-1500	7.4-9.0	<4.0	Moderate	3	Medium
Havre	>60	Well drained	High 8.4-12.0	B	700-1600	7.4-8.4	2.0-12.0	Moderate	3	Slow
Ravalli	>60	Well drained	Moderately High --	C	400-750	7.6-9.6	<4.0	Low	5	Slow
Rock River	>60	Well drained	Moderately High 7.0-8.3	B	700-1500	6.6-9.0	<2.0-4.0	Moderate	3	Slow

HANNA SOUTH APPENDIX
(Continued)

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES) [3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH)[6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Ryan Park	>60	Well drained	Low 3.6-4.9	B	700-1500	6.6-9.0	<.0	Moderate	2	Medium
Santanka	35	Well drained	Low 3.5-5.5	B	600-1400	7.4-9.0	<2.0	Moderate	3	Medium
Shinbara	5-10	Somewhat excess-ively well drained	Very Low 0.75-2.0	D	250-600	8.2-8.8	2.0-4.0	Low	4L	Medium to Rapid
#15	>60	Well Drained	Moderately High	B	700-1200	8.0-8.4	----	Moderate	--	Medium

1. Depth of Effective Rooting Zone: Is an indicator of the depth to which plant roots would penetrate soil profile.
2. Drainage Class: Is an indication of soil profile-moisture relationships.
3. Available Water Capaicity: Refers to the soil profiles potential water holding capacity for utilization by plants.
4. Hydrologic Soil Group: This grouping places soils to their potential to yield runoff; Group A being low and Group D being high.
5. Potential Production (#/ac. Dry Wt.): Refers to SCS Form 5 Potential Vegetative Production calculations from unfavorable to favorable years for each series.
6. Soil Reaction (pH): The degree of acidity or alkalinity of a soil expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: slightly acid, 6.1-6.5; neutral, 6.6-7.3; slightly alkaline, 7.4-7.8; moderately alkaline 7.9-8.4; strongly alkaline, 8.5-9.0; and very strongly alkaline, 9.1.
7. Salinity (mmhos/cm): Refers to the soluble salts in a soil, based on the electrical conductivity of the saturation extract, as expressed in millimhos per centimeter (mmhos/cm) at 25 C.

Salinity rating	mmhos/cm
Low	4
Moderate	4-8
High	8

8. Inherent Fertility: The following criteria were used for rating the soils.
   Low Soils low in available P or K, or with pH below 5.0 and above 9.0 in the A and upper B horizons, or soils having levels of moisture (A.W.H.C.), or growth of plants is severely limited.
   Moderate Soils intermediate between low and high in inherent fertility.
   High Soils high in available P and K, with pH of 5.5 or less than 8.4 in the A and upper B horizons, levels of moisture (A.W.H.C.), or alkalinity are such that choices or growth of plants are not limited.
9. Wind Erodable Group: Refers to the erodability of soil surface; rate 1-8 with 1 being the most erodable and 8 being non-erosive.
10. Runoff: Refers to the relative rate that water flows off soil surface 6 classes: Ponded, very slow, slow, medium, rapid, very rapid.

HANNA SOUTH APPENDIX

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL[2]	CLASSIFICATION[3] DEPTHS (INCHES)	USDA	UNIFIED	AASHO	DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
Blackhall	251	Loamy, mixed (cal-careous), frigid, shallow Ustic Tor-riorthent	Residuum from soft sandstones	0-12 0-12	FSL,VFSL GR-VFSL	SM, SM-SC SM	A-4 A-2,A-4	10-20	0.6-2.0	Low	Low
Blazon	252,253, 254	Loamy, mixed (calcar-cous), frigid, shallow Ustic Torriorthent	Interbedded sand-stone, loam stone and sandy shales	0-14 0-14 0-14	CL L GR-CL	CL ML, CL-ML GM	A-6 A-4 A-6	10-20	0.2-2.0	Low	Moderate Low Moderate
Bullock	245	Fine-loamy, mixed Borollic Natrargid	Residuum from interbedded soft sandstone and silty and clayey shales	0-4 0-4 4-9 9-22	FSL SIL, L SCL, CL, L SL, L, CL	SM,SM-SC,ML ML, CL-ML SC, CL SC,SM-SC,CL	A-4 A-4 A-4, A-6 A-4, A-6	20-40	0.6-2.0	Low	Low Low Moderate Moderate
Forelle	210,	Fine-loamy, mixed Borollic Haplargid	Alluvium from sandstones and shales	0-4 4-20 20-60	L CL, L GR-SCL	CL-ML, ML CL GC, SC	A-4 A-6 A-2	>60	0.6-20	Moderate	Low Moderate Moderate
Glendive	257	Coarse-loamy, mixed (calcareous), frigid Ustic Torrifluvent	Sandy alluvium on flood plains	0-16 16-60	L,SIL,FSL SR-FSL-LFS	ML,CL-ML SM	A-4 A-4, A-2	>60	0.6-2.0	Moderate	Low
Grieves	251	Coarse-loamy, mixed (calcareous), frigid Ustic Torriorthent	Alluvium from calcareous sand-stone	0-14 14-60	FSL FSL	SM,SM-SC SM,SM-SC	A-4 A-4	>60	0.6-2.0	Low	Low

HANNA SOUTH APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL [2]	CLASSIFICATION [3]				DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
				DEPTHS (INCHES)	USDA	UNIFIED	AASHO				
Harve	257	Fine-loamy, mixed	Stratified	0-8	L	ML,CL,CL-ML	A-4	>60	0.2-0.6	Moderate	Low
		(calcareous), frigid	alluvium on flood	0-8	SICL	CL	A-6				Moderate
		Ustic Torrifluvent	plains and stream	8-60	L,FSL	ML	A-4				Low
			terraces								
Ravalli	210	Fine-loamy, mixed	Alluvium from	0-2	SL	SM	A-4, A-2	>60	0.06-0.2	Low	Moderate
		Borollic Natrargid	alkaline shales	2-14	L	ML	A-4				
				14-20	CL	CL	A-6				
				20-60	L, VFSL	ML	A-4				
Rock River	258	Fine-loamy, mixed	Alluvium from	0-3	SL	SM	A-2	>60	0.6-2.0	Low	Low
	260	Borollic Haplargid	sandstone	3-19	SCL	SM, SM-SC	A-4				
				19-60	SL	SM	A-2				
Ryan Park	260	Coarse-loamy, mixed	Alluvium from	0-4	LFS,SL,LS	SM	A-2	>60	2.0-6.0	Low	Low
		Borollic Haplargid	sandstone	4-18	SL,FSL	SM-SC	A-2, A-4				
				18-60	SL,LS	SM	A-2, A-4				
Satanka	258,	Fine-loamy, mixed	Residuum from	0-4	FSL	SM	A-4	35	0.6-2.0	Low	Low
	253	Borollic Haplarig	soft sedimentary	0-4	GR-FSL	GM, SM	A-2				
			rocks	4-35	SCL GR-SCL	SC,GC	A-2, A-6				
Shinbara	252	Loamy, mixed (calcar-	Residuum from	0-8	L	CL-ML, ML	A-4	2-10	0.6-2.0	Low	Low
		eous), frigid, shallow	siltstone and	0-8	GR-L	CM-GC, GM	A-4				
		Ustic Torriorthent	loamstone								

HANNA SOUTH APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL [2]	CLASSIFICATION [3]				DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
				DEPTHS (INCHES)	USDA	UNIFIED	AASHO				
#15	210	Fine-loamy mixed Borollic Camborthid	Alluvium	0-45 45-60	L SL	---	---	>60	---	---	---

1. Classification: Classification of each soil series according to Soil Taxonomy USDA 1975.

2. Parent Material: Geologic material that soil developed from.

3. Classification: Depths are of soil profiles, USDA classification is the soil textural classification system, the unified and AASHO classifications are used by engineers unfamiliar with the USDA textrual classification system.

4. Depth To Bedrock: Refers to the soil range in depth to bedrock.

5. Permeability: Refers to the rate at which water and air may move through the soil.

6. Potential Frost Action: Refers to the probable effects on structures resulting from the freezing and thawing of soils.

7. Shrink/Swell Potential: Refers to the quality of a soil that determines its volumemetic changes resulting from wetting and drying of soil profile.

SEMINOE I
proposed project

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

BACKGROUND

In September 1976, Arch Mineral Corporation submitted a mining and reclamation plan modification to the Office of the Area Mining Supervisor, Geological Survey (GS), Denver, Colorado. The plan calls for expansion (4 year life span) of the ongoing (since 1972) surface mining operation at the Seminoe I Mine, located on federal and private coal acreage approximately 33 miles northeast of Rawlins and 10 miles west of Hanna, Wyoming (see Figure SI1-1 and Map SI1-1). Additional information was filed in November 1976 and January 1977. An updated mining and reclamation plan and additional environmental data were submitted to GS on January 6, 1978. The plan was accepted by GS for review. Construction and mining would begin in 1979; mining would require 25 permanent employees.

The mining and reclamation plan included in this statement was submitted for review during or prior to promulgation of the initial regulations (30 CFR 700) required under Sections 502 and 523 of the Surface Mining and Control and Reclamation Act, (SMCRA) of 1977 (P.L. 95-87) and has not been officially reviewed for compliance therewith. Therefore, the applicant's plan may not fully reflect the requirements of the initial regulations. However, in this statement the initial regulations are considered as required federal mitigating measures the same as all other applicable regulations.

The mining and reclamation plan will be returned to the operator for revision in accordance with the applicable initial regulations. As soon as the applicant's plan is revised and returned to GS it will be evaluated with the Office of Surface Mining to determine compliance with the requirements of Federal Regulations 30 CFR 211 and 30 CFR 700. The mining and reclamation plan cannot be approved until it conforms to all applicable federal requirements.

The Seminoe I Mine amendment area lies within the checkerboard land ownership pattern and contains 3,840 acres including 960 acres of leased federal coal and 2,880 acres of privately owned coal. The project is located in on 960 acres of federal coal lease W-16465. It is located Section 30 and W½, Section 32, T. 22 N., R. 82 W., 6th P.M. The rest of the project area is owned by Rocky Mountain Energy Company and area ranchers, and is leased by Arch Mineral.

The mine plan modification and supporting data submitted by Arch Mineral are on file at the Office of the Area Mining Supervisor, GS, Conservation Division, Denver, Colorado, and at the District Office, Bureau of Land Management, Rawlins, Wyoming, and can be reviewed by the public at those locations.

PROPOSED ACTION

The action before the federal government is to consider for approval the mining and reclamation plan presented by Arch Mineral Corporation.

Purpose and Objectives

The purpose of this proposed action is to allow mining of 5.2 million tons of coal at an average rate of 1.3 million tons per year. The specific objective is to supply 1.3 million tons of a projected 2.3 million tons of coal per year from the Seminoe I Mine to Midwestern markets (see Figure SI1-2).

Location

The existing surface facilities are on both private and public land in Section 16 and 17, T. 22 N., R. 83 W. (see Map SI1-2). The surface and coal ownership are shown on Map SI1-3 and listed in Table SI1-1.

Predisturbance Inventories and Analyses

Specific inventories were conducted under the direction and/or cooperation of Arch Mineral in consultation with the BLM concerning threatened and endangered plants and animals, raptor nesting sites, archeological sites, historical sites, and paleontological localities.

An inventory was conducted by the BLM of the proposed Seminoe I project area for proposed endangered and/or threatened plant species. The inventory did not reveal the presence of any plants listed on the current (1977) list of proposed endangered and/or threatened species.

The Wyoming State Game and Fish Commission conducted an inventory, funded by BLM, of raptor nesting sites on and adjacent to the project area. No nests (active or inactive) were found in areas which would be physically disturbed by the mining operations.

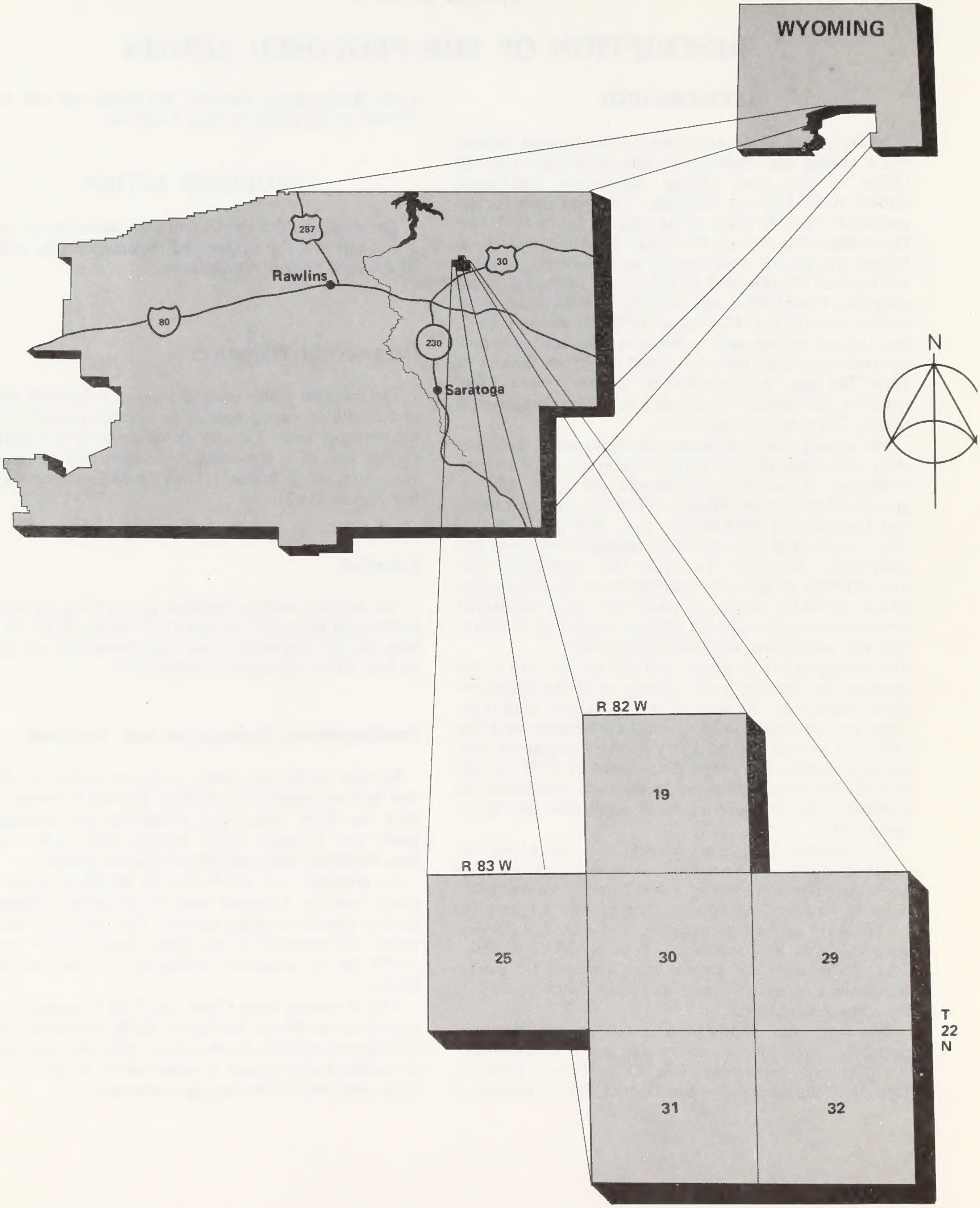
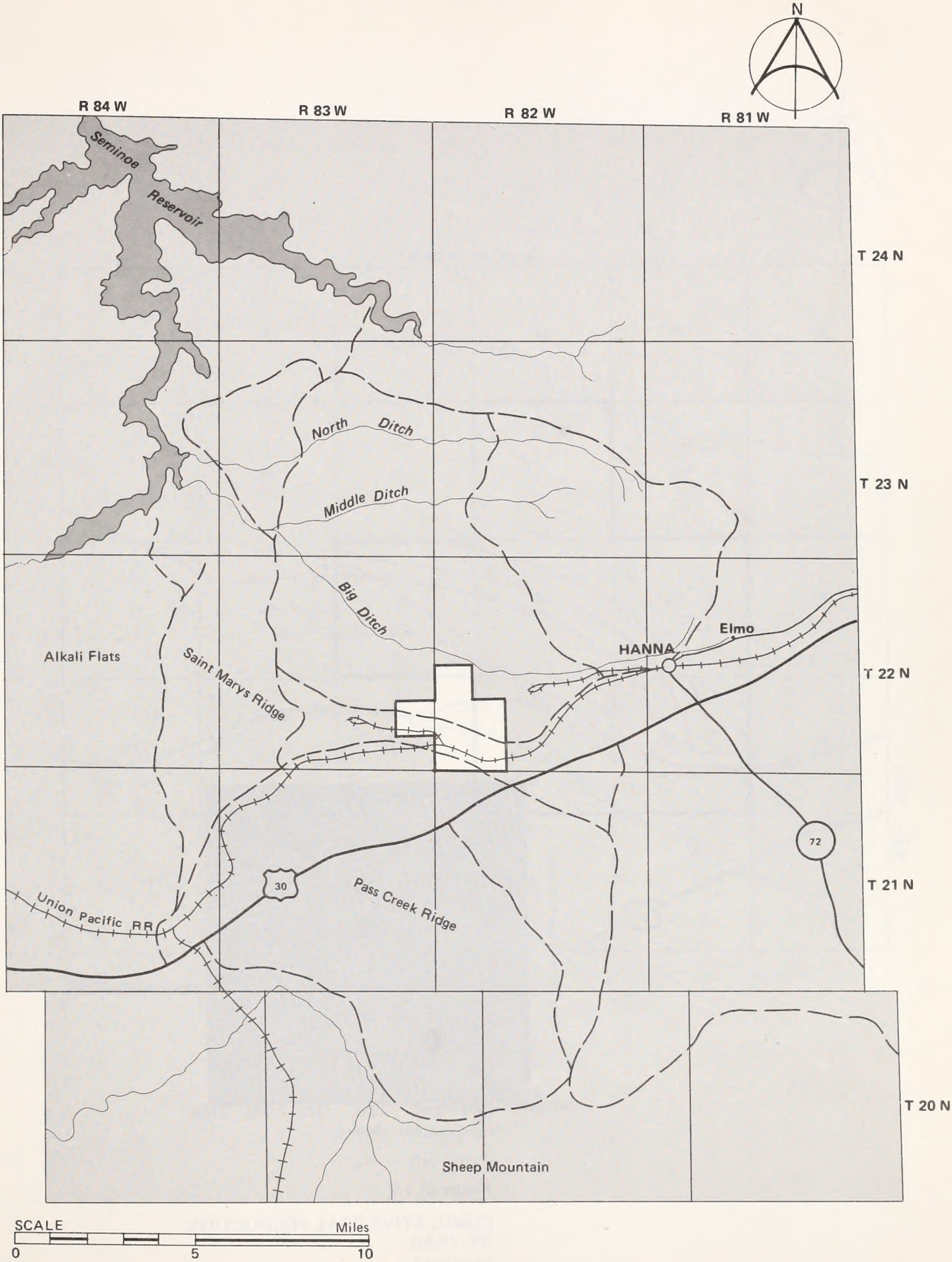


Figure SI 1-1

GENERAL LOCATION
Seminoe I



Map SI 1-1

VICINITY MAP
Seminoe I

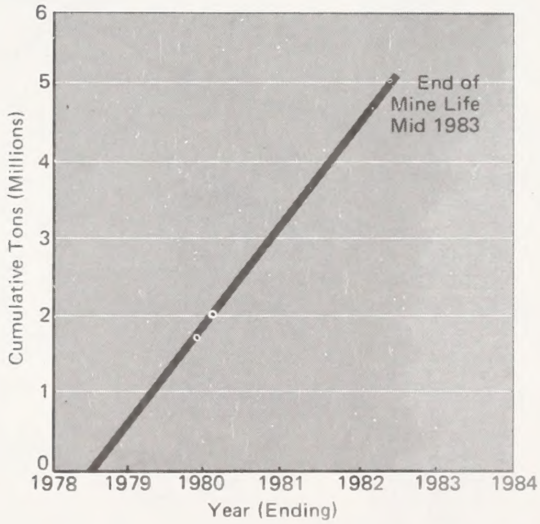
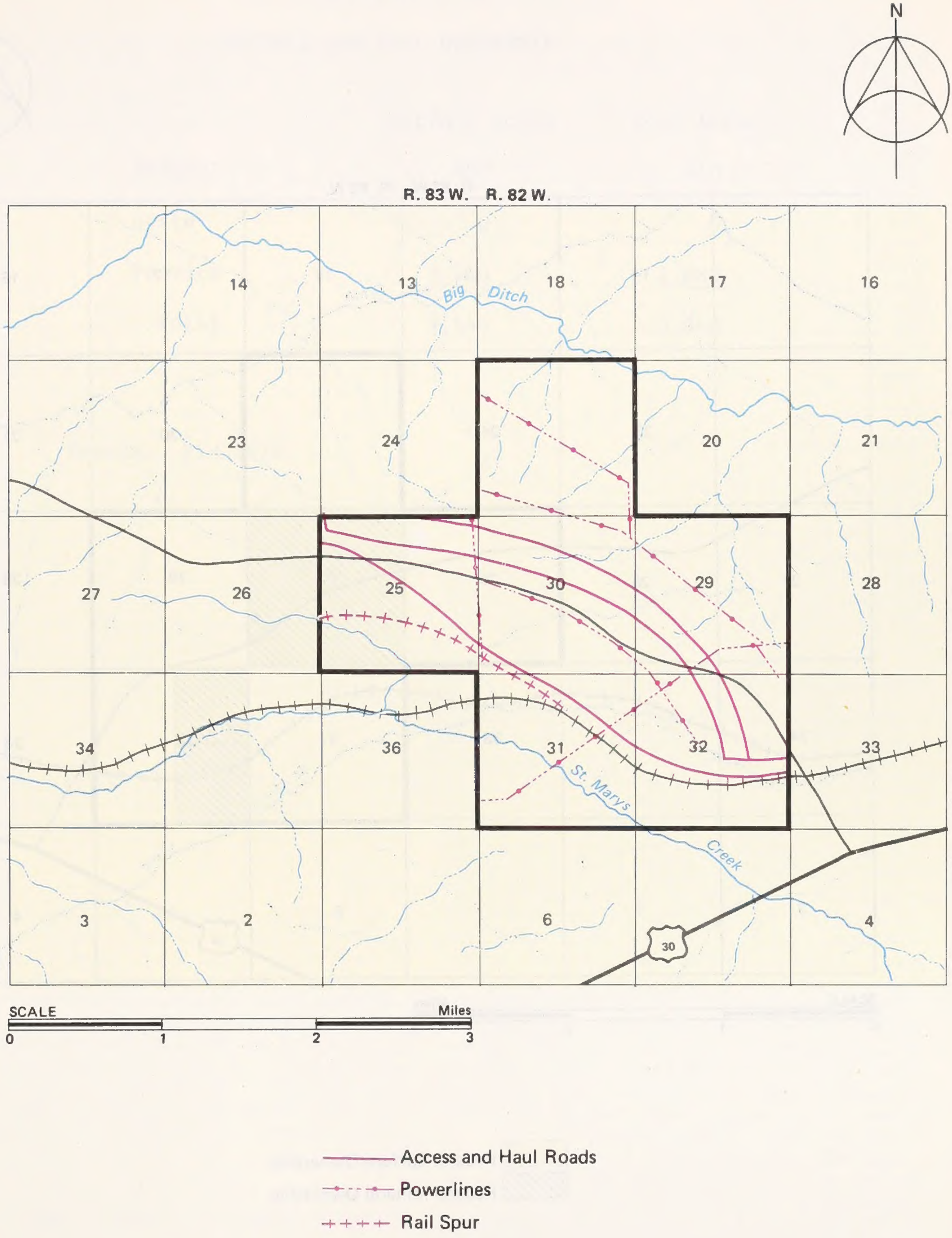


Figure SI 1-2

CUMULATIVE COAL PRODUCTION BY YEAR
Seminoe I



Map SI 1-2

MINING AND ANCILLARY FACILITIES
Seminoe I

Map SI 1-3

SURFACE AND MINERAL OWNERSHIP
Seminoe I

Table SI1-1

SURFACE AND COAL OWNERSHIP

	Surface Acres	Coal Acres
Federal	800	960
State	0	0
Private	3,040	2,880
Total	3,840	3,840

Source: BLM 1978

The Fish and Wildlife Service plans to conduct an inventory for black-footed ferrets. The survey will be funded by BLM.

The State Historic Preservation Officer was consulted concerning any National Register sites within the project area.

A cultural inventory was conducted on the project area during 1976 by the University of Wyoming. Further testing is planned. Section 106 documentation will be initiated for any sites determined to be of National Register quality.

An Order III soil survey was conducted on the project area by the Soil Conservation Service. In accordance with the mining and reclamation plan, analyses of the overburden will be made for physical and chemical properties.

Mine and Related Facilities

The Seminoe I project would not require construction of any additional rail spurs, main power lines, or buildings. New haul roads and a 115-kv power line would be constructed to service the various pit areas. A 4.1-mile section of the access road would have to be relocated. The ongoing mine is a typical dragline-stripping operation (see Figure SI1-3).

Mining and Coal Handling Equipment

Overburden would be removed by a 75 cubic yard Bucyrus Erie 1570 dragline, haulage trucks, front-end loaders, rear-dump trucks, and miscellaneous service vehicles. Blast hole drills would be of the 40 R or 60 R Bucyrus Erie type. Bulldozers would be a Caterpillar D-9 type or similar. Motor graders would be Caterpillar 14 to 16 models. Coal haulage trucks would be end or bottom-dump truck of 85 or 100 ton capacity. Front-end loaders would be Caterpillar 966 or 992 or similar size.

It is expected that the mining equipment would consume about 1 million gallons of diesel fuel and 100,000 gallons of gasoline in addition to an unspecified amount of electric power during the life of the mine.

Existing coal handling facilities would be used. These facilities include a dump hopper, crushing plant structure, and storage piles. The dump hopper receives run-of-mine coal from the off highway bottom-dump truck and provides surge protection. The crushing plant houses primary and secondary crushers, as well as a refuse hopper. Capacity is 1,500 tons per hour.

Coal from the storage piles is transported by conveyors from the bottom of the storage pile to the unit train loading facility. The coal is weighed before sampling and loading. Provisions for sampling the coal are included in the coal handling equipment; coal testing facilities are available.

Office and Shop

The office and shop structures for the existing Seminoe I Mine are located in Sections 16 and 17, T. 22 N., R. 83 W., at the termination of the railroad spur and access road and at the origin of the mine service and coal haul roads. These structures would be used for the mine expansion.

Support Developments

Roads

Highway access to the Seminoe I area is via U.S. Highway 30. The access road is about 7 miles long, and connects to Highway 30 in Section 4, T. 21 N., R. 82 W. About 3.5 miles of this road now located within the project area would be relocated to the south. An additional 0.6 miles of off-site access road would have to be constructed. A telephone line about 4.0 miles long would be constructed along the access road.

New haul roads would be constructed as needed. Secondary haul roads would be constructed from the main haul roads to the active pit areas as needed. Service roads would connect the main haul road with the area behind the highwall to give access to the draglines and drills, and would be moved as the highwall advances. The haul roads would be 75 feet wide and the service roads would be about 30 feet wide. Haul and service roads would be constructed of gravel or clinker found at or near the mine. All roads would be constructed in conformance with Federal Regulations 30 CFR 715.17(1).

Railroad Spur

The existing rail spur which ends in Sections 16 and 17, T. 22 N., R. 83 W., would be used throughout the mine life.

Utilities

Power for operating the dragline and overburden drills would be provided by extending a 115-kv system to the various mining blocks. Lines would be constructed, moved, and removed as the mining operation advances within blocks and moves from one block to another. The existing 34.5-kv power line would be dismantled upon completion of the 115-kv line. All mine-related power lines would be constructed in accordance with standards established in the U.S. Department of Agriculture's bulletin, REA Bulletin 61-10, to reduce accidental electrocution of raptors. Mine water is supplied from an existing well.

Proposed Mine Layout and Mining Sequence

The Seminoe I Mine is oriented generally westward, and the proposed expansion would be mined in two blocks. Beginning in the southernmost block, the first cut would be made along the south edge of the area to be

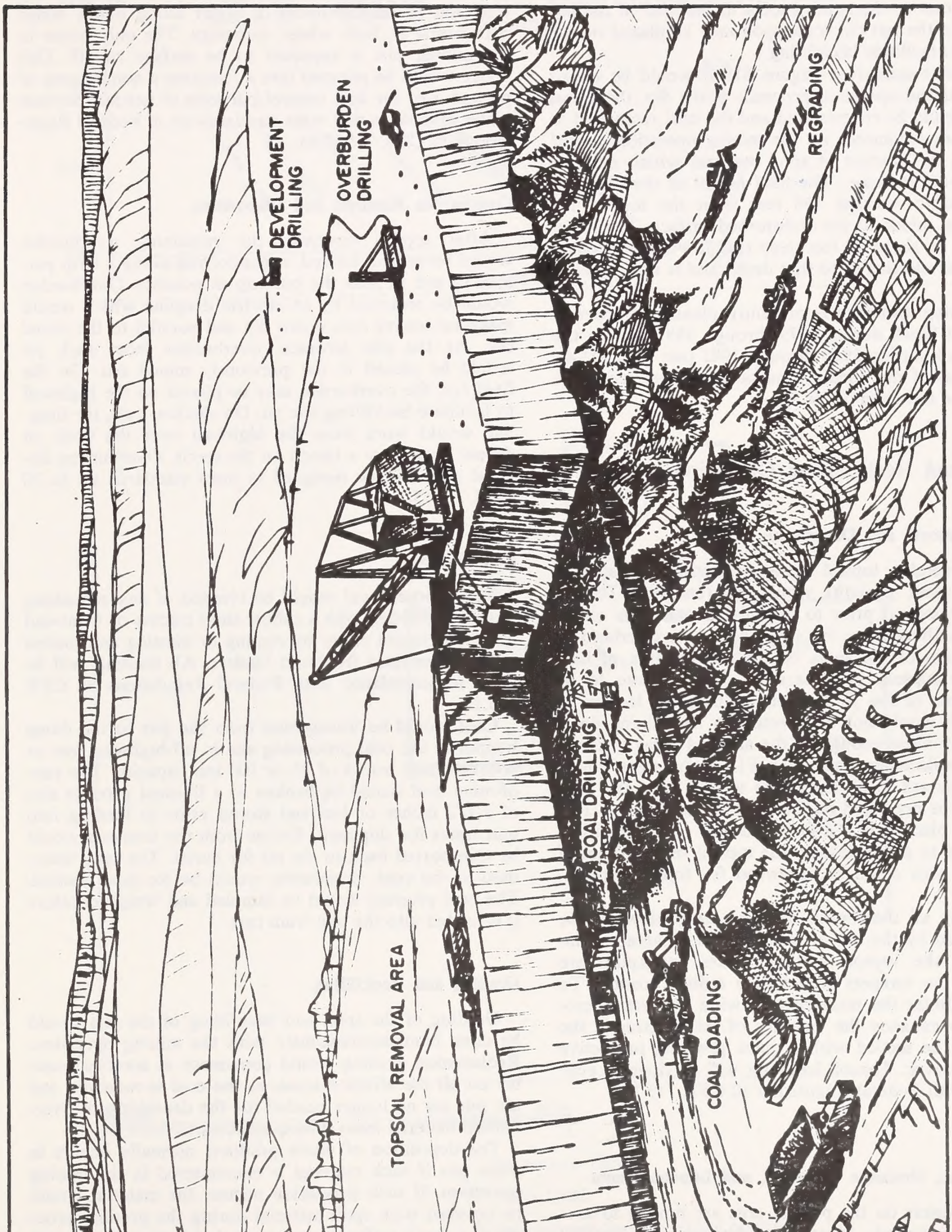


Figure SI 1-3
ARTISTS CONCEPTION OF TYPICAL DRAGLINE MINE OPERATION

mined; each successive cut would be to the north. Spoil would be cast to the south except in the case of the last cut. During the last cut some spoil may be placed on the highwall to facilitate backfilling.

The lowest seam (see Figure SI1-4) would be mined first and, as the operation proceeds down dip, the seams above it would be encountered and the coal recovered as the highwall advanced. As the mining operation moved down dip, the amount of spoil material which must be moved would increase. The final height of the highwall is expected to average 150 feet from the top of the lowest seam mined to the undisturbed surface. The initial cut would be about 20 feet deep (the low-wall), because the coal has weathered to that depth and is not marketable.

The mining sequence is presently planned to operate on the first block during 1979 through 1981 and on the second block during 1980 through 1983 (see Map SI1-4). On the basis of the mining sequence, acreages would be disturbed as shown in Table SI1-2.

Mining and Reclamation Operations

Topsoil Removal and Deposition

All recoverable topsoil material (material capable of sustaining plant growth) would be removed. Topsoil would be removed prior to the mining operation on all areas to be affected by the stripping of the overburden, the deposition of the spoil, or the construction of haul roads. The topsoil, in most cases, would have to be stored in one of the 28 stockpiles which are located in areas which would not be affected by the mining operation yet are close enough to the affected areas to facilitate easy replacement (see Map SI1-5). In areas where multiple cuts are to be made, the topsoil from the later cuts would be deposited on the spoil of the first cut. This would take place only if a sufficient area of the spoil had been graded to accommodate the topsoil removed and if the graded area could be approved for topsoil replacement.

Practically all the topsoil material removal would be accomplished by the use of scrapers. The inherent compaction of the topsoil material when stockpiles are formed by the scrapers would help reduce erosion. To further minimize the possibility of wind and water erosion and to enhance the viability of soil organisms the piles would be seeded with a quick growing protective vegetative cover. Topsoil handling will be done in conformance with Federal Regulation 30 CFR 715.16.

Watercourses, Drainage Channels, and Impoundments

Surface waters on the project area are limited to several small stockponds. Most major drainages run parallel to the present and proposed pits and no major disruption of these drainage patterns is foreseen. All permanent roads would be ditched where possible to control any runoff. Culverts would be constructed to alleviate any retention or impoundment of water along roads; water bars would be built where necessary. The only water in the mining pits is expected to be surface runoff. This water would be pumped into a temporary nonuse area of pit and used for dust control purposes as needed. Surface water diversions will meet standards set in Federal Regulations 30 CFR 715.17(a).

Overburden Removal and Disposition

After topsoil removal, the remaining overburden would be drilled, blasted, and removed along a strip parallel to and as near the outcrop as possible. Overburden would be removed by an electric dragline which would make successive cuts down dip and parallel to the initial cut. As the pits advance, overburden from each pit would be placed in the previously mined cut. On the final cut, the overburden may be placed on the highwall to facilitate backfilling the pit. On shallow cuts, the dragline would work from the highwall over the coal; on deeper cuts, from a bench on the spoils. Overburden disposal sites will be designed to meet standards set in 30 CFR 715.15.

Coal Removal

The exposed coal would be cleaned of any remaining loose overburden with a rubber-tired tractor or front-end loader, loosened either by ripping or blasting and loaded with rubber-tired front-end loaders. All blasting will be done in accordance with Federal Regulations 30 CFR 715.19.

Coal would be transported from the pits to the dump hopper at the coal processing site in off-highway rear or bottom-dump trucks of 85 or 100 ton capacity. The run-of-mine coal would be broken to a finished product size of 1-1/2 inches or less and stored prior to loading into unit trains for shipment. Refuse from the breakers would be transported back to the pit for burial. The only water used in the coal preparation would be for dust control. The coal product would be sampled and weighed before it is loaded into the unit train cars.

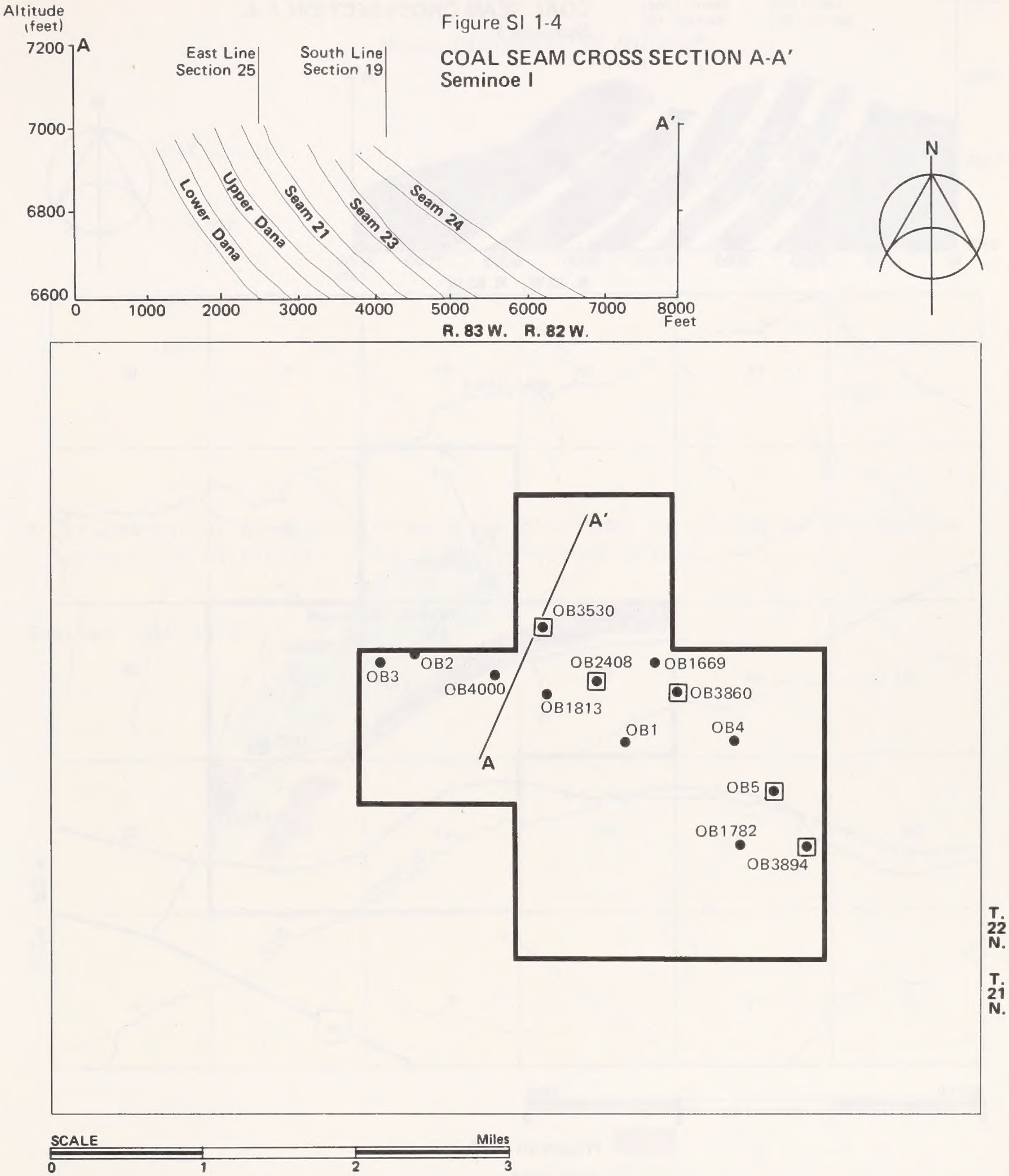
Grading and Backfilling

Grading of the spoil and backfilling of the pits would be done contemporaneously with the mining operation. Reclamation grading would commence as soon as possible on all the affected areas, as the coal is removed and the pits are no longer needed for the deposition of overburden material from subsequent cuts.

The deposition of waste products normally occurs in these pits if such material is encountered in the mining operation. If such deposition occurs, the material would be covered with spoil material during the grading process to a depth sufficient to ensure that it remains covered and also to ensure it does not hamper the revegetation effort. A minimum depth of 5 feet of soil over such material would be sufficient for this purpose.

Figure SI 1-4

COAL SEAM CROSS SECTION A-A'
Seminoe I



Present to 1980

1981-1985

• Overburden Sample Hole Locations

▣ Overburden Unsuitable for Reclamation

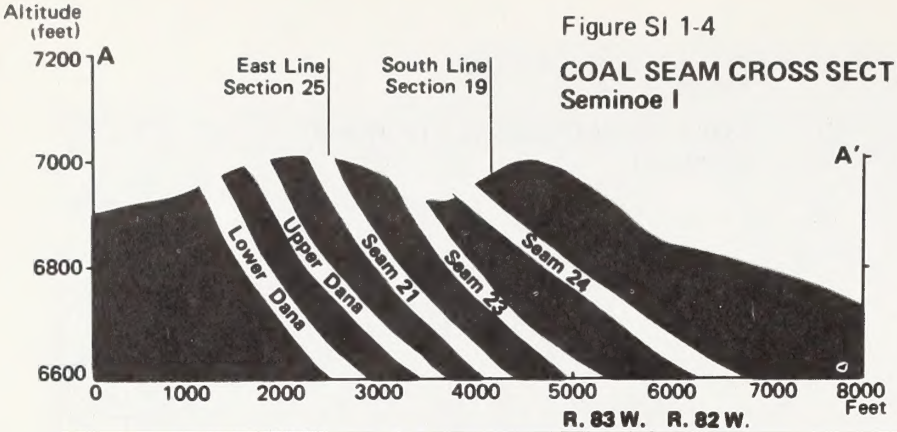
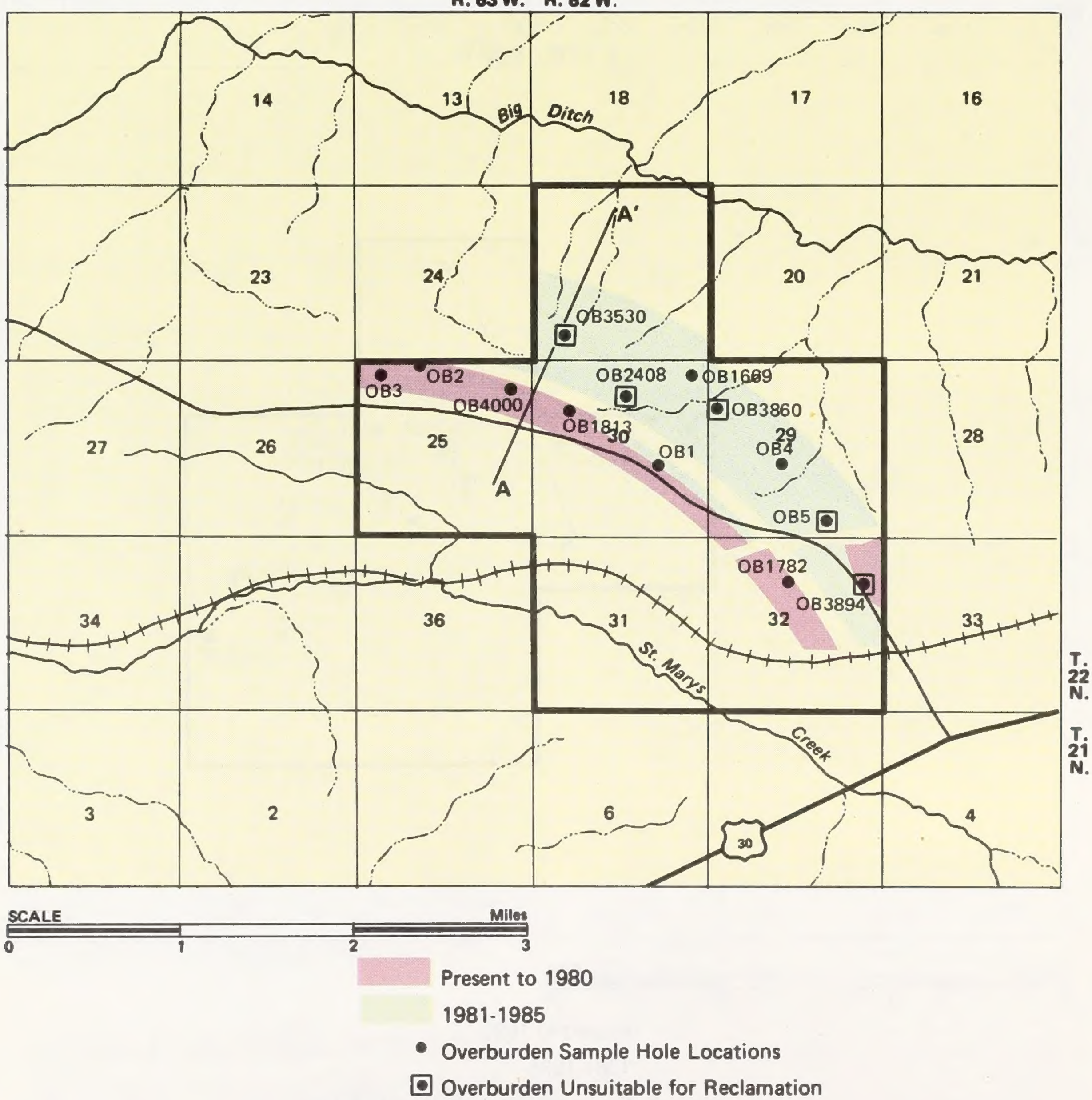


Figure SI 1-4

COAL SEAM CROSS SECTION A-A'
Seminoe I



Map SI 1-4

MINING SEQUENCE MAP
Seminoe I

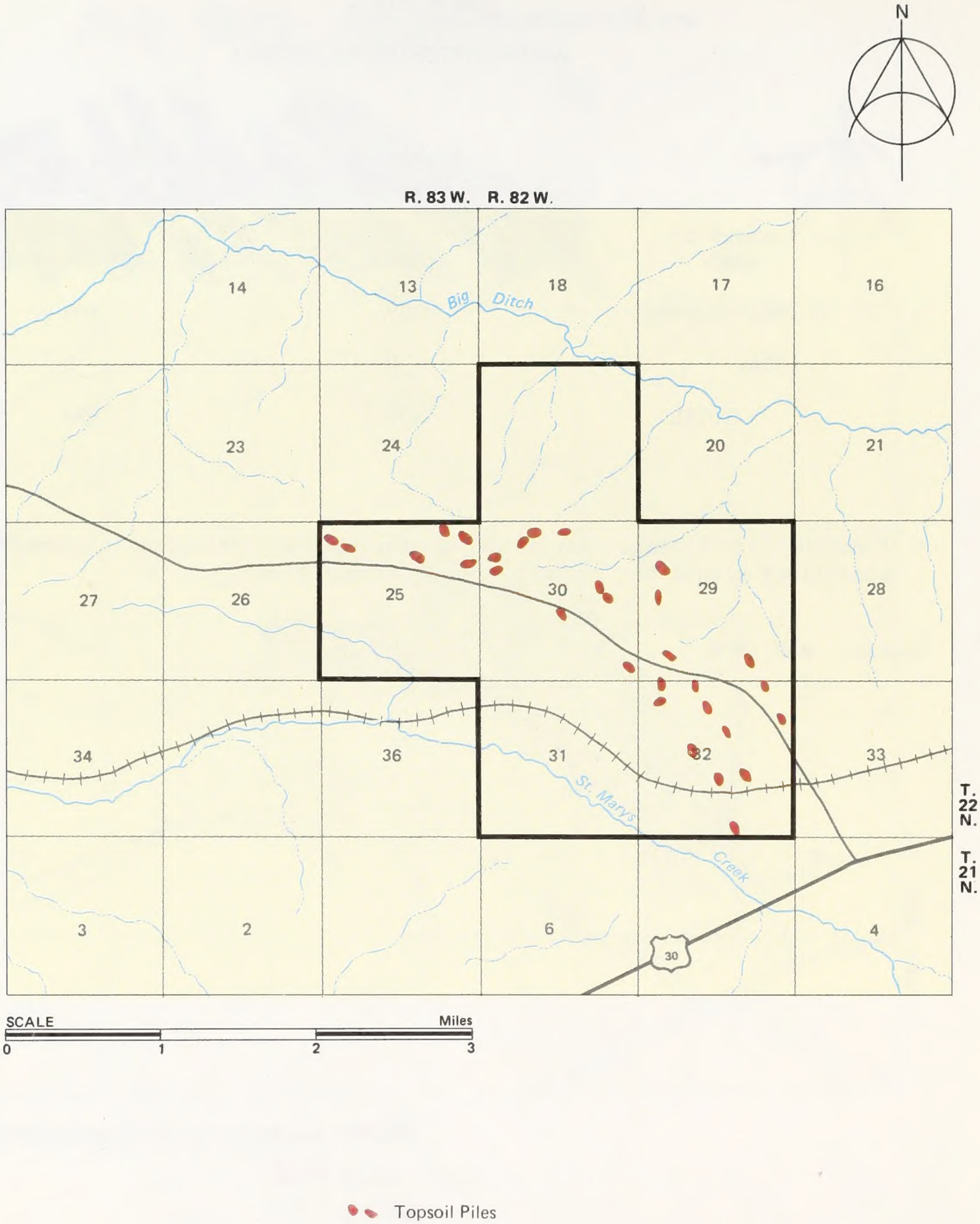
Table SI1-2

ACRES DISTURBED BY MINING*

Year	Public Acres Disturbed	Private Acres Disturbed
Present to 1980	208	294
1981 to 1985	199	704
1986+	0	0
TOTAL	407	998

* Final Contour Acreage--all acreages disturbed by mining and reclamation operations within the project area (Noncumulative)

Source: BLM 1978



Map SI 1-5

TOPSOIL STORAGE
Seminoe I

The grading design used and the slope degree at which spoil would be graded would take into account the natural slopes in the area, the erodibility of the spoil material, the slope exposure, and the economics of the reclamation work involved.

The reclamation grading process would be done by track and/or rubber tired equipment in the sequence outlined above. The heavy equipment should compact the soil enough to aid in stabilizing the slopes without seriously retarding vegetative reestablishment and growth. If the soil does become severely compacted, a disc or chisel plow would be used to break up compaction before attempts were made to revegetate the area.

On spoils that do not have a large amount of rock near the surface, a road grader would be used to blade the slopes on the contour. This action would leave small windrows of soil along the contour to aid in erosion control.

Slopes would be graded to a minimum of 3:5:1 (horizontal:vertical) depending on the overall natural configuration in the immediate vicinity of the spoil. Attempts would be made, when possible, to blend the graded spoil into the natural terrain to make it appear as natural as possible. The south and west expsoure of the soils would receive special consideration, since these slopes pose more problems in vegetative establishment than do the north and east exposures. Backfilling and grading will be done in conformance with 30 CFR 715.14.

Topsoil Replacement and Erosion Control Measures

Scrapers would replace the topsoil material to a depth of 4 to 8 inches on the graded overburden and mine pit areas. This replacement soil material would come from the 28 stockpiles or directly from new areas of disturbance.

On long slopes, especially highwall slopes, where runoff could produce very damaging erosion, level benches would be left at various elevations along the slope in order to prevent the surface runoff from building up an extreme amount of speed. By reducing the velocity at which the water runs down the slope, the erosion which could be caused would also be reduced. For this same reason modified terraces may be used. Another method to be used in controlling erosion on graded areas would be to change the angle of the slope while doing the grading. The angle of the slope would alternately flatten and steepen slightly as the grading was done. This would form areas where the runoff would be slowed so that a large amount of erosive force would not be built up.

During the grading process the slopes would be left in a roughened condition. This, plus the slight compaction accomplished by the grading equipment, would be the only soil preparation done in the majority of areas. If more intense preparation were needed, one or more surface manipulation treatments would be used in order to provide a firm seedbed for vegetation. The surface manipulations being considered are modified terraces, gouging, dozer basins, chisel plowing, disking and the use of a road grader on the contour of the slope.

In nearby areas, the company has found that fertilization of reclamation areas has not been necessary to achieve plant growth. Available moisture, not nutrients, is the principle limiting factor. If revegetation attempts in the future prove to be unsuccessful and soil analysis determined fertilization to be necessary, then a fertilizer program would be established and tested in an effort to establish successful revegetation.

Planting and Revegetation

The Seminoe I coal mining operation, pursuant to Section 515 of SMCRA and 30 CFR 715.13, will be required as a minimum, to restore the lands affected to a condition capable of supporting the use which they were capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. A mining permit will not be approved unless the applicant has demonstrated that reclamation to the proposed mining land use can be accomplished under the reclamation plan contained in the permit application (Section 510, SMCRA).

Implementation of the reclamation plan would include seedbed preparation, establishing seed mixes, seeding, and evaluation. Topsoil handling and seedbed preparation will be done in conformance with 30 CFR 715.16 and 715.20.

Following the grading phase of the reclamation operation and the replacement of topsoil on the graded areas, a diverse vegetation cover would be seeded on the reclaimed areas. This cover would primarily consist of native vegetation, grasses, browse species, and some fast growing introduced species seeded to provide protection for the soil from erosion and to provide protection for the native grass seedlings from the elements until the native species take over.

Because the interbedded sandstones and shales produce a wide variety of textures within a short distance, the broad-spectrum mix found in Table SI1-3 is recommended for miscellaneous roads, soil stockpiles, drill sites, power and pipelines.

Larger areas, such as the mine spoil, should have a mixture tailored for the characteristics of the spoil. Crested wheatgrass has been deleted from the seed mixture. Mixtures for the above described range sites are available in the Arch Mineral field office technical guide.

In areas where there is a potential problem of serious erosion, as exists with the topsoiled areas, a quick growing annual plant such as wheat, oats, or rye may be planted in an effort to stabilize the soil. This cover crop would be left as a standing mulch to protect the soil from both wind and water erosion. During the seeding period following the planting of this cover mulch, the area would be seeded to the regular grass mixture.

In most cases the seeding work would be done with a rangeland drill with depth bands attached. The seed would be placed 1/4 to 3/4 of an inch below the surface of the soil and covered. The spacing would be approxi-

Table SI 1-3

TEMPORARY RECLAMATION SEED MIXTURE

Critana	Thickspike wheatgrass	5 pounds
Sodar	Streambank wheatgrass	5 pounds
Rosana	Western wheatgrass	5 pounds
	Yellow sweetclover	½ pound
Drilled at:		15½ pounds

Source: Seminoe I Reclamation Plan

mately 7 inches between rows. Every effort would be made to prepare a relatively firm seedbed which is free from competition from noxious weeds. A modified grain drill would be used only in flat areas. Broadcast seeding would be done only on areas not suited for use of the rangeland drill or the modified grain drill. A reclamation seed table is illustrated in Table SI1-4.

The majority of seeding would be done in the fall of the year, usually to commence in mid-September. Some seeding would also be accomplished during the spring, especially in early April. Seeding at this time would probably consist of planting of the cover mulch in preparation for the seeding of the area to the grass mixture during the fall.

Decommissioning and Abandonment

Final abandonment of the property would include the removal of all facilities except those deemed necessary or desirable for subsequent uses, subject to the approval of the area mining supervisor and affected surface owners. The disturbed sites would be graded, covered with topsoil, and seeded (see Table SI 1-5).

Present and Future Land Use

The current and past uses of the project area have been primarily livestock grazing, wildlife forage, and hunting in the fall. Carrying capacity for grazing is closely tied to vegetative productivity, particularly to those species with high forage value. Wildlife use is associated with both food availability and cover. Cover involves both vegetation and landforms; important vegetative cover includes shrubs and grasses. Based upon these aspects, the proposed uses of the reclaimed lands (as recommended in the Hanna Land Use Plan) include both grazing for domestic livestock and wildlife habitat. The standard for determining if adequate grazing has been restored for the support of domestic livestock will be based upon vegetative cover and forage productivity. The company proposes to give special considerations for wildlife habitat (seed mixture changes, etc.) on approximately 25% of disturbed acreages during reclamation.

Management of Reclaimed Areas

Once the area is reclaimed with a satisfactory vegetative cover being well established and ready for grazing, management would be returned to the surface owner or user.

Pollution Control Methods

No problem is anticipated due to noise pollution. The wide open spaces and almost constant wind tend to disperse any noise created.

Dust would be controlled by wetting (by a mixture of water and Coherex) of the haul roads. The water used for this purpose would be collected from accumulated runoff in the pits or pumped from Seminoe Reservoir at a rate of not more than 50 acre-feet per year. The use of water from Seminoe would be covered by contract with the Bureau of Reclamation.

Contamination of the air by coal dust would be lessened by utilization of a stacker tube in the stockpile. Also, oil sprays are used at the tipple to aid in dust suppression.

If material creating a fire hazard were uncovered during the mining, it would be removed, covered, or buried. Wastes would be stabilized by constructing waste piles in compacted layers with incombustible and impervious materials. Waste containing coal would be stored separately. Culverts or bridges would be installed where necessary to allow access by the surface owner and mine operator for fire control purposes.

Temporary diversion ditches would be seeded with approved grasses where appropriate, and culverts installed where necessary. In no case would diversion ditches discharge directly upon topsoil storage areas, spoil piles, or other unconsolidated material.

Any toxic material would be buried under at least 5 feet of soil to prevent contamination. Spoil piles, where necessary, would be compacted to prevent leaching of toxic materials.

During mining, water quality monitoring would be done as needed and would be coordinated with the applicable federal and state government agencies. A surface water monitoring plan will be designed in conformance with 30 CFR 715.17(b).

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposed action. A more complete description of the authorizations is provided in Chapter 1 of the Regional Analysis.

Assistant Secretary of Energy and Minerals

The Assistant Secretary shall approve the mining permit application and significant modifications or amendments thereto prior to commencement of mining operations by the company. The mining permit application includes the proposed mining and reclamation plan.

Office of Surface Mining (OSM)

OSM, with concurrence of the surface managing agency (BLM) and GS, recommends approval or disapproval of a mining and reclamation plan to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a state-federal cooperative agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and

Table SI 1-4

RECLAMATION SEED TABLE

Grass	Percent	Pounds Seed/Acre	Number Seeds/Pound
Critana Thickspike Wheatgrass	23	3.50	156,000
Rosana Western Wheatgrass	23	3.50	110,000
Slender Wheatgrass	24	2.85	159,000
Fourwing Saltbush	15	1.50	22,000
Indian Ricegrass	5	0.75	141,000
Yellow Sweetclover	10	1.00	172,000

Source: Seminoe I Reclamation Plan

Table SI 1-5

TOTAL CUMULATIVE DISTURBED AND RECLAIMED ACRES
SEMINOE I*

Year	Public Acres		Private Acres	
	Disturbed	Reclaimed	Disturbed	Reclaimed
Present to 1980	216	2	332	4
1981 to 1985	416	415	1,044	1,020

*Reclaimed Acres involves time for backfilling, grading, contouring, topsoil replacement, and initial seeding.

Source: BLM 1978

mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and department authorized to take final actions on the permit.

Bureau of Land Management (BLM)

The BLM developes the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources other than coal and the post-mining land use of the affected lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, power lines, communication lines, and railroad spurs on public lands.

Geological Survey (GS)

GS is responsible for development, production, and coal resource recovery requirements included in the mining permit.

State and County

Wyoming Department of Environmental Quality (DEQ)

Whenever Wyoming enters into a cooperative agreement with the Secretary of the Interior pursuant to section 523(c) of SMCRA, DEQ, and OSM will jointly review and act on mining and reclamation plans and permits to mines authorized under a federal coal lease.

The Land Quality Division would issue a permit and license to mine upon its approval of a mining and reclamation plan. The Air Quality Division would issue permits to construct and permits to operate crushers or other point sources after a review of applications with regard to air contaminants and plans for control and monitoring. The Water Quality Division would issue permits to construct waste water systems. They also would issue National Pollutant Discharge Elimination System (NPDES) permits for discharging waste water. The Solid Waste Division would issue construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation.

Wyoming State Engineer

Use of surface or groundwater for mining and coal processing operations would require a permit from the State Engineer.

INTERRELATIONSHIPS

BLM

The Hanna Management Framework Plan (MFP) recommends coal mining on the proposed Seminoe I amendment area. Other MFP recommendations (Hanna and Overland MFPs) that relate to coal development are for the BLM to provide additional land for community development in Rawlins, Saratoga, and Wamsutter. The BLM would provide land for sanitary landfills—one near Saratoga and one in a central location for Hanna, Elk Mountain, and Elmo. The BLM plans to allocate land for schools, parks, etc., for development of a water treatment plant in Rawlins, and for airport expansion in Rawlins. Preliminary sites have been recommended for these land transfers; however, final designations have not been made. The post mining land uses on the project area will be wildlife habitat and livestock grazing as recommended in the Hanna MFP.

State, County, and Local

The Seminoe I project area is zoned for ranching, agriculture, and mining; therefore, no conflicting uses are foreseen.

Relationship to Regional Development

Other Coal

The Seminoe I Mine amendment would produce 7% of the projected 27.8 million tons of coal produced in the Hanna area by 1980 and 5% of the 111.3 million tons produced by 1985. This production would be 7% of the projected regional production of 27.8 million tons by 1980 and 4% of the 121.3 million tons by 1985.

Other Regional Development

The proposed Seminoe I Mine amendment would be developed during the same time frame as other coal mine development in the Hanna Basin, uranium development in the Red Desert and Baggs areas, the ongoing regional exploration and development of oil and gas, and the regional increase in general construction to meet population needs.

Relationship to Regional Impacts

Development of Seminoe I Mine would add to the cumulative regional demand for labor, and would compete with other development occurring in the same time frame.

Relationship to Rail Transportation Systems

The project would not require any additional train traffic since the coal would be shipped in trains presently utilized by the Seminoe I Mine.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

The climate of southcentral Wyoming is characterized by dry air masses, which are modified Pacific air masses moving eastward over the Rocky Mountains. The largest moisture source is easterly winds which provide most of the precipitation. In the summer, most of the precipitation in the area is a result of thunderstorms. Annual precipitation is low at 10 inches per year, most of which is the result of spring and early summer thunderstorm activity. Lake evaporation on other land, is estimated to be about 36 to 42 inches annually. The prevailing winds are south to southwest. Northerly and westerly are also common.

The proposed Seminoe I Mine site is located about 30 miles east northeast of Rawlins in Carbon County. Temperatures at the site average about 43°F annually. Winds are generally out of the southwest for much of the year with an average speed of 11 mph (Figure SI2-1). Stable atmospheric conditions prevail about 80% of the time because of the cold temperature and moderately strong winds. Surface-based inversions are frequent despite the high average wind speeds. They occur in the mornings between 75% and 85% of the time annually; most frequently in summer, least frequently in spring. During afternoons, they are uncommon except in winter when they are observed about one-third of the time.

AIR QUALITY

Particulate air quality in undeveloped areas of southcentral Wyoming ranges from 19 micrograms per cubic meter ($\mu g/m^3$) to 31 $\mu g/m^3$ annual geometric mean as recorded at five state and privately operated particulate sampling sites. The mean concentration at the five samplers is 25 $\mu g/m^3$ and the median is 24 $\mu g/m^3$.

Two samplers were operated by Rocky Mountain Energy in Carbon County from January through December of 1977. These samplers were located at the Adams Ranch and at the Curry Ranch. The sampler at the Adams Ranch recorded an annual geometric mean of 31 $\mu g/m^3$ and maximum values of 136 $\mu g/m^3$ and 106 $\mu g/m^3$. The sampler at the Curry Ranch produced an annual geometric mean of 30 $\mu g/m^3$ and maximum values of 86 $\mu g/m^3$ and 71 $\mu g/m^3$. These data being the most recent, the existing particulate air quality at the Seminoe I site is considered to be 31 $\mu g/m^3$.

There has been no intensive monitoring of gaseous pollutants in the area. Sampling for sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) was conducted at the Patrick Draw site for 3 months in 1976 (Wyoming Department of Environmental Quality 1977). Though these data are not of sufficient duration to specifically quantify the presence of these pollutants in the area, it may be interpreted as an indicator of these pollutant levels at the site. The arithmetic mean concentrations recorded for SO_2 and NO_2 were 27 $\mu g/m^3$ and 19 $\mu g/m^3$ respectively (Wyoming Department of Environmental Quality 1977), both of which are well below the annual Wyoming State standard of 100 $\mu g/m^3$ and 60 $\mu g/m^3$ for NO_2 and SO_2 respectively.

Visibility at the site ranges from less than 1 mile to greater than 60 miles throughout the year. Average visibility ranges from about 26 to 47 miles with greatest visibility occurring during spring and summer months.

GEOLOGY

Stratigraphy and Structure

The proposed project area lies in the southwestern part of a structural province known as the Hanna Basin (see Map 4, in Appendix A).

The only formation that crops out in the Seminoe I area is the Ferris Formation of Paleocene and Upper Cretaceous age (60 to 80 million years ago), except for a small part of the southwest corner which consists of the North Park Formation of Miocene age (about 20 million years ago). The Ferris Formation contains six seams of coal which would be mined (see Mineral Resources for details). The coal seams dip northeast toward the center of Hanna Basin at angles of 20 to 30 degrees (Dobbin et al. 1929). These dip angles are generally steeper than those for coal seams being considered for mining in other parts of the basin, because the seams are closer to the basin rim.

The North Park unconformity, overlying the Ferris Formation, represents a gap in time of about 40 million years. The unconformity is angular; the North Park strata are relatively horizontal.

Geologic Hazards

There are no known active faults in the area, and the area is one of low seismicity. The formations to be mined are not known to be particularly susceptible to sliding.

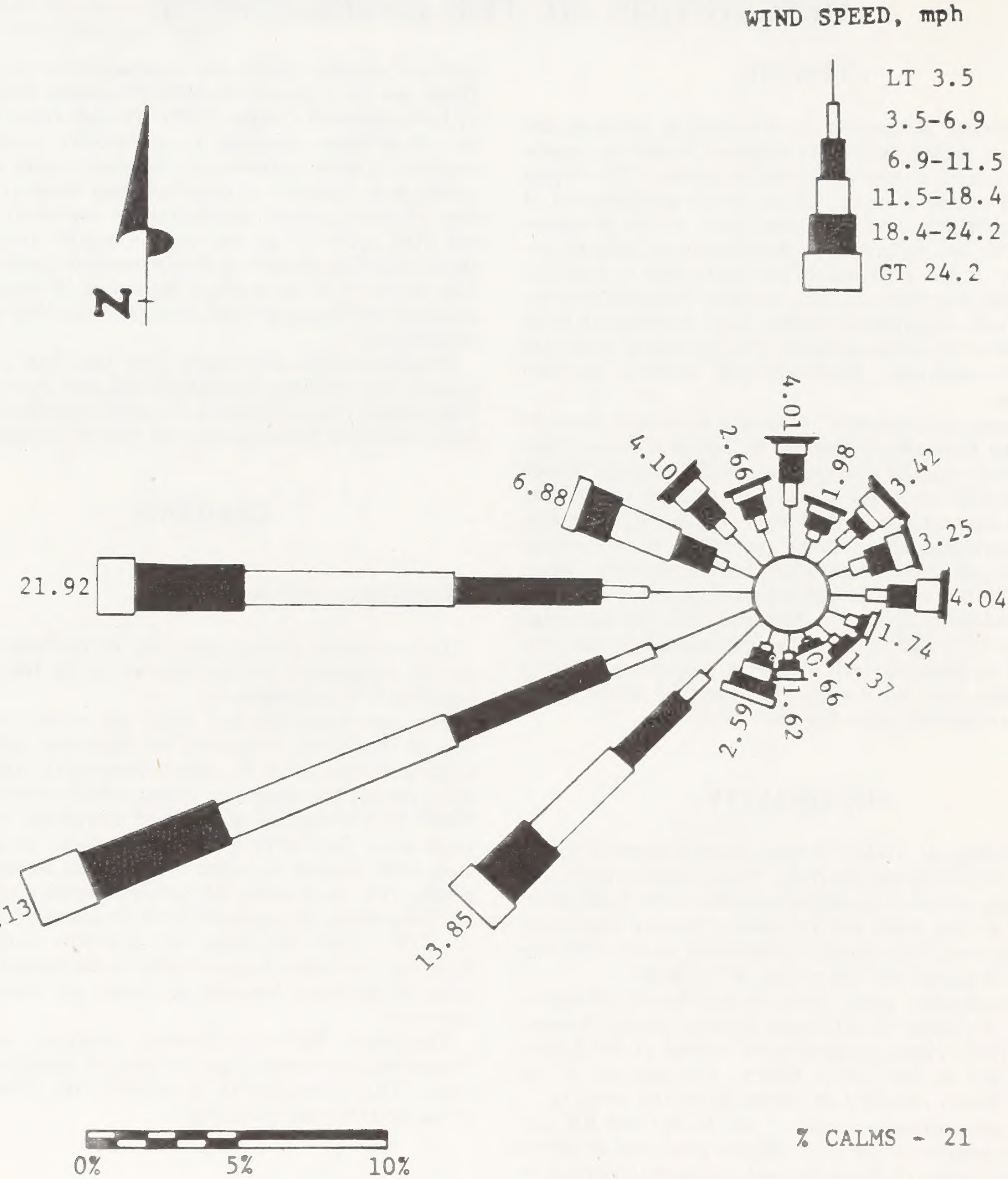


FIGURE SI2-1

ANNUAL WIND ROSE FOR THE PROPOSED
SEMINOE I MINE SITE

Source: National Climatic Center, STAR Program for Selected U.S. Cities, 1968. (Rawlins, Wyoming).

Paleontology

The project area has not been surveyed for paleontological resources. A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in the proposed project area is presented in Table SI2-1.

TOPOGRAPHY

The average elevation of the Seminoe I project area is 7,000 feet (see Map 1 in Appendix A). The area contains northwest trending ridges, having a relief of 50 to 100 feet, which reflect the northeast dipping resistant members of the Ferris Formation. The area is drained to the west by Saint Mary's Creek which is a tributary of the North Platte River.

SOILS

Soil data for the Seminoe I project area were taken from an Order III soil survey report done by the Soil Conservation Service (SCS) for the Bureau of Land Management in the summer of 1977 (USDA, SCS 1978). Additional data were correlated from the survey done by Mine Reclamation Consultants Inc. (MRC) of Laramie, Wyoming, in the fall of 1976 (MRC 1976.d). The soil survey of the Seminoe I project area conforms to the latest accepted practices of the National Cooperative Soil Survey Program using the new Soil Taxonomy, USDA, 1975. Mapping units are based upon soil types with similar properties. Separation is at family, association, complex, or series level. Additional units were not shown in each mapping unit if they were too small or complex to delineate or if the soil survey was not detailed enough to describe them.

Some of the principal soils found on the Seminoe I project area that would be disturbed by surface mining are in mapping units 252, 253, 254, and 258 (see Map SI2-1). Soils of mapping unit 252 characteristically occur on moderately steep and steep residual uplands with sharp ridge crests and slope breaks. These loams to fine sandy loams have a high erosion potential, steep slopes, very shallow depths, and rock outcrops, making them poor sources of soil material for reclamation.

The soils of mapping unit 253 characteristically occur on rolling to hilly residual uplands. These loams to sandy clay loams have a moderate to high erosion potential, gently sloping to moderately steep slopes, and shallow depths, making them poor to fair sources of soil material for reclamation.

The soils of mapping unit 254 characteristically occur on gently sloping and sloping upland ridges and side slopes. These loam soils have a moderate to high erosion potential, rolling slopes, and shallow to moderately deep depths, making them fair to poor sources of soil material for reclamation.

The soils of mapping unit 258 characteristically occur on alluvial fans from adjacent uplands. These sandy loams to sandy clay loam soils have a low to moderate erosion potential, nearly level to sloping slopes, and deep depths, making them good to fair sources of soil material for reclamation.

A soil use interpretation summary for the mapping units (Map SI2-1) is shown in Table SI2-2.

Detailed soil use interpretations for and descriptions of the mapping units are given in the Seminoe I Appendix.

WATER RESOURCES

Groundwater

The geologic unit that would be mined is the Ferris Formation. Aquifers in this unit are thin, discontinuous layers of sandstone, conglomerate, and coal, which dip to the north and northeastward toward Big Ditch. The aquifers are very low producers, having transmissivities of generally less than 100 gallons per day per foot of aquifer width (gpd/ft). Permeabilities are generally less than 5 gpd/ft^2.

The regional water table slopes generally from Hanna toward Seminoe Reservoir (see Maps R2-7 and SI2-2). Within the project area, the water table slopes toward Saint Mary's Creek and Big Ditch from a low ridge between them. A small but unknown amount of recharge occurs along this ridge, and water moves to Big Ditch.

Depths to water in and near the project area are highly variable ranging from a few feet along Big Ditch and St. Mary's Creek to over 700 feet near the Vanguard underground mine in Section 8, T. 22 N., R. 82 W. Groundwater has not been encountered in pits of the existing Seminoe I Mine, but was encountered at depths of 40 to 90 feet in pit areas in the proposed expansion.

Surface Water

The Seminoe I area drains to Big Ditch and Saint Mary's Creek. Roughly 5 miles of Big Ditch tributaries drain the north half of the project area, while 1.3 miles of Saint Mary's Creek, along with 5 miles of its tributaries, drain the south half. Both the named creeks and their tributaries are basically ephemeral within this area. They flow only a few days each year, but there may be some small seeps and springs along the valley floors.

The stream beds in the area are composed of fine gravel, sand, clay, and silt. Gully erosion is predominant throughout the upper tributaries indicating that large sediment loads are carried by undisturbed streams. The average slope of Saint Mary's Creek across this area is 16 feet per mile while the tributaries sometimes have slopes as high as 300 feet per mile.

Floods are of no great consequence in the proposed mine area where the largest stream drains about 200 acres. The 100-year flood on such a drainage is roughly 100 cubic feet per second (Lowham 1976).

Table SI2-1

SUMMARY OF FOSSIL LOCALITIES IN THE AREA OF THE PROPOSED SEMINOE I MINE

Formation	Period	Known Fossil Localities	Type of Fossils
Ferris	Lower Paleocene/ Upper Cretaceous	General	I.V.P.
North Park	Miocene	General	V*

General - Formation produces fossils with no specific localities identified.

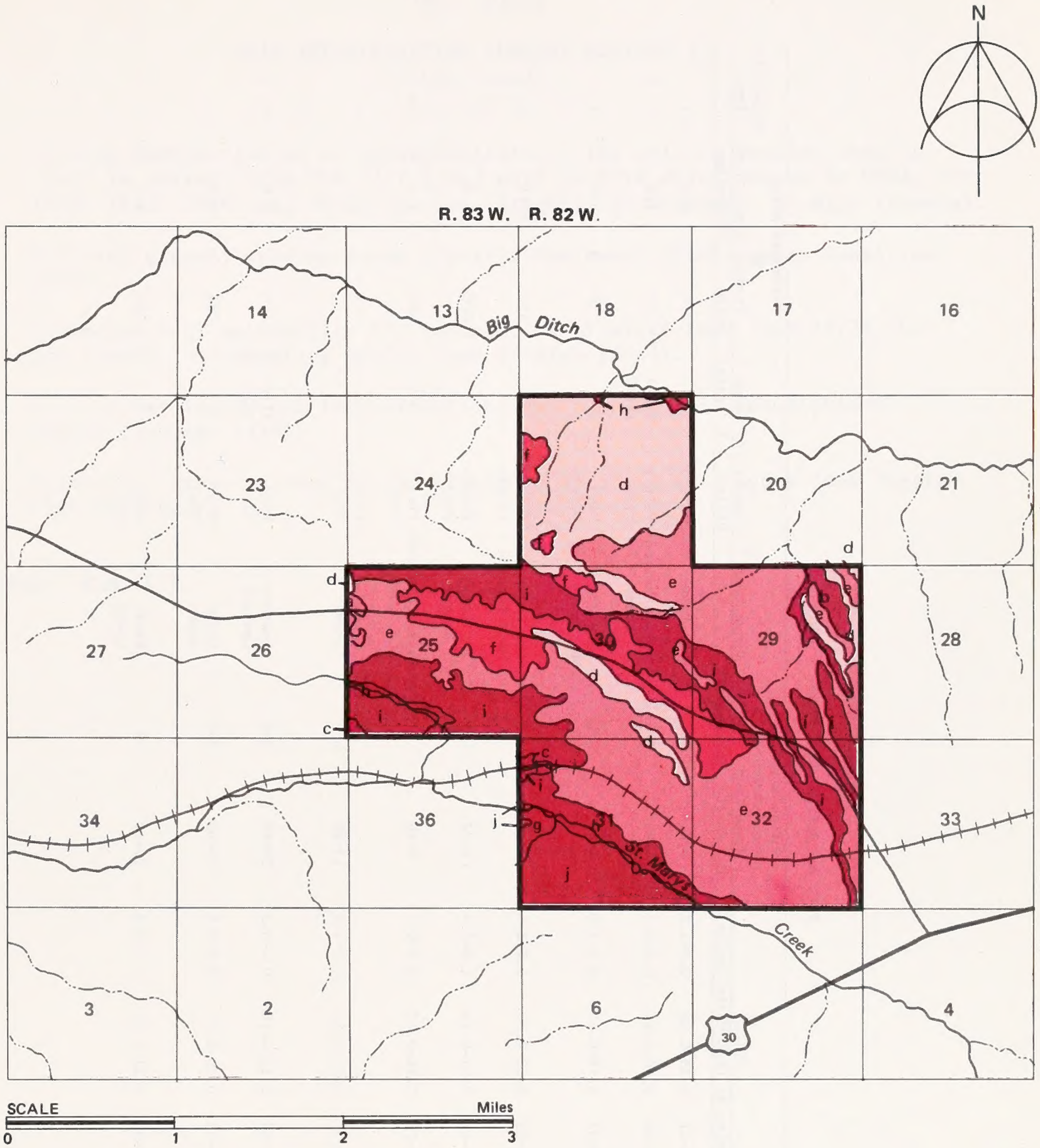
I - Invertebrate

V - Vertebrate

P - Paleobotanical

*Extremely rare

Source: BLM 1978



Deep (greater than 40 inches)
Moderately Deep (20-40 inches)
Shallow (10-20 inches)
Very Shallow (0-10 inches)

a. 90B - Blazon loam, 5% - 15% slopes
b. 210 - Ravalli-Forelle-15 complex, 0-6% slopes
c. 251 - Grieves-Blackhall association, 2%-20% slopes
d. 252 - Shinbara-Blazon-Rock Outcrop complex, 6%-30% slopes
e. 253 - Blazon-Satanka association, 2%-15% slopes
f. 254 - Bullock-Blazon complex 0-6% slopes
g. 256 - McFadden-Rock River complex, 0-20% slopes
h. 257 - Havre-Glendive soils, 0-6% slopes
i. 258 - Rock River-Satanka association 0-12% slopes
j. 260 - Ryan Park-Rock River association 2%-20% slopes

Map SI 2-1

SOILS
Seminoe I

Table SI2-2

SOIL INTERPRETATION SUMMARY - SEMINOE I

Soil Unit		Erosion Hazard Potential[1]		PSIAC[2]			Suitability for Final Cover for Mined Land[3]		Range Site[4]	Capability Group[4]		Estimated Acres in Project Area		Vegetative Type[5]
Symbol	% Slopes	Water	Wind	Rating	Ac Ft/SqMi/Yr	Ton/Ac/Yr	In. Avail.	Suitability		Dryland	Irrigated	Acres	Percentage	
90B	5-15	H	M	31-41	0.25-0.36	0.8-1.2	0-6	L	Sh. Loamy	VIIe14		14	0.4	4
210	0-3	L	M	24-29	0.20-0.24	0.6-0.8	14-60	M-H	Saline Upland	VIIs71	VIs71	78	2.0	14, 4
	3-6	M	M						Loamy	VIe2	IIIe2			
251	2-6	M	M	27-37	0.18-0.31	0.6-1.0	4-60	L-H	Sandy	VIe5		16	0.4	4
	6-15	M	H						Sh. Sandy	VIIe14				
	15-20	H	H											
252	6-15	M	M	51-61	0.52-0.74	1.7-2.4	0-6	L	Sh. Loamy	VIIs17		656	17.1	4
	15-20	H	M						Very Shallow	VIIe14				
253	2-6	M	M	37-47	0.31-0.45	1.0-1.4	6-27	L-M	Sh. Loamy	VIIe14		1,578	41.2	4
	6-15	M	M						Loamy	VIe2				
254	0-3	L	M	32-27	0.18-0.22	0.6-0.7	6-10	L	Impervious Clay	VIe1		350	9.1	4a
	3-6	M	M						Sh. Loamy	VIIe14				
256	0-3	L	H						Sandy	VIe5		24	0.4	4
	3-6	M	H	26-37	0.21-0.31	0.7-1.0	13-60	L-H	Loamy	VIe2				
	6-15	M	H											
	15-20	H	H											
257	0-3	L	M	14-19	0.13-0.16	0.4-0.5	30-60	M-H	Lowland	VIe2	IIIe2	146	3.8	14, 4
									Lowland	VIe5	IIIe5			
258	0-3	L	M	24-32	0.20-0.27	0.6-0.9	17-60	M-H	Loamy	VIe2		781	20.3	4
	3-6	L	M						Loamy	VIe2				
	6-12	M	M											
260	2-6	L	H	26-33	0.21-0.27	0.7-0.9	26-60	H	Sandy	VIe5		197	5.1	4
	6-15	M	H						Loamy	VIe2				
	15-20	H	H											

Table SI2-2

SOIL INTERPRETATION SUMMARY-SEMINOE I
(Continued)

1. Erosion hazard classes or susceptibility of the soil to erosion when no cover is present from BLM 7317.1 and soil profile descriptions in USDA, SCS 1978, 1977, 1976, and 1972. L--Low (Slight) M--Moderate H--High (Severe).

2. Estimate present erosion rates (Pacific Southwest Inter-Agengy Committee 1968).

3. Estimated soil suitability for reclamation of mined land (BLM 7312); L--Low (Poor), M--Moderate (Fair), and H--High (Good).

4. Soil survey legend and interpretations and mapping unit descriptions SSA630 (January 1978).

5. Vegetative types adapted to and likely to occur on soil types (see Vegetation section).

Source: BLM 1978

Map SI 2-2

WATER RESOURCES
Seminoe I

The 7 mile long reach of Big Ditch from the proposed expansion to the mouth at Seminoe Reservoir is paralleled and crossed by the mine access road and rail spur for Medicine Bow Mine. The stream is blocked by one or more settling basins. Water reaches Seminoe Reservoir only when the combined amount of surface runoff and water pumped from mine pits exceeds the capacity of the basins, which have small culvert-type spillways.

Quality

Water in the coal-bearing units on the north side of the ridge is not acceptable for human consumption, but is acceptable for stock. However, water from south of the coal outcrop has over 5,000 milligrams per liter (mg/l) of total dissolved solids and is unsuitable even for livestock. Water from other strata may be of better quality. For example, the well drilled by Arch Mineral to supply the needs of the office and shop area of the existing Seminoe I Mine contains water suitable for human consumption according to the Wyoming State Health Department.

No surface water quality data are available for sites within the project area. The flow of Big Ditch is monitored for quality by the GS approximately 9.5 miles downstream from Seminoe I. Monitoring began in August 1974, and to date only limited information is available.

The two samples that had been taken prior to June 1977 contained 2,000 to 3,000 mg/l of dissolved solids and even at a low flow of 1.6 cubic feet per second (cfs) contained 2,170 mg/l of suspended solids. The field value of pH was 8.5 to 8.6. These samples may reflect changes caused by existing mines, but there are no premining data for comparison.

Water Use

Wells for the Seminoe I Mine are located in Sections 20 and 22 T. 22 N., R. 83 W. One well yields 20 gallons per minute (gpm) and another yields 10 gpm. Energy Development Company has water rights for two wells each in Sections 18, 20, and 22, T. 22 N., R. 82 W. One of these, in the alluvium near Big Creek, yields 50 gpm that is used for mine operations. The other wells are used for dewatering underground mines. No other wells exist within 3 miles of the proposed expansion.

The GS topographic map prepared in 1971 shows four stock reservoirs either in or immediately adjacent to the project area. These reservoirs do not appear to be registered with the Wyoming State Engineer, because Westinghouse (1977) lists no registered surface rights other than those of Arch Mineral Corporation.

VEGETATION

Terrestrial

The vegetative cover on the lands included in the proposed Seminoe I project area is composed of three types. For the general description of these types, refer to the description presented in the Regional Analysis, Chapter 2, Vegetation. The geographic locations of the range types on the project area are shown on Map SI2-3. The acreage and percent distribution of the three types on the project area are shown in Table SI2-3.

Big Sagebrush

In the big sagebrush type, Wyoming big sagebrush occurs in uniform age-height stands on a variety of soils and range sites. This species commonly occupies the non-salty bottom areas, east-facing range sites, and wind-protected pockets where deeper soils and above average moisture conditions exist. Big sagebrush average between 3 and 4 feet high and comprise an average cover between 30% and 40%, (often exceeding 60%) on bottomland sites and along drainages.

Understory species on bottomland sites differ from upland sites. The bottomland sites include such understory species as Kentucky bluegrass, Canby bluegrass, and basin wildrye. Thickspike wheatgrass, Sandberg bluegrass, bottlebrush squirreltail, needleandthread, Indian ricegrass, bluebunch wheatgrass, and Hoods phlox constitute the major understory species within the upland big sagebrush communities. On shallow upland soils, this type is characterized by shorter plants and more widely dispersed individual plant patterns.

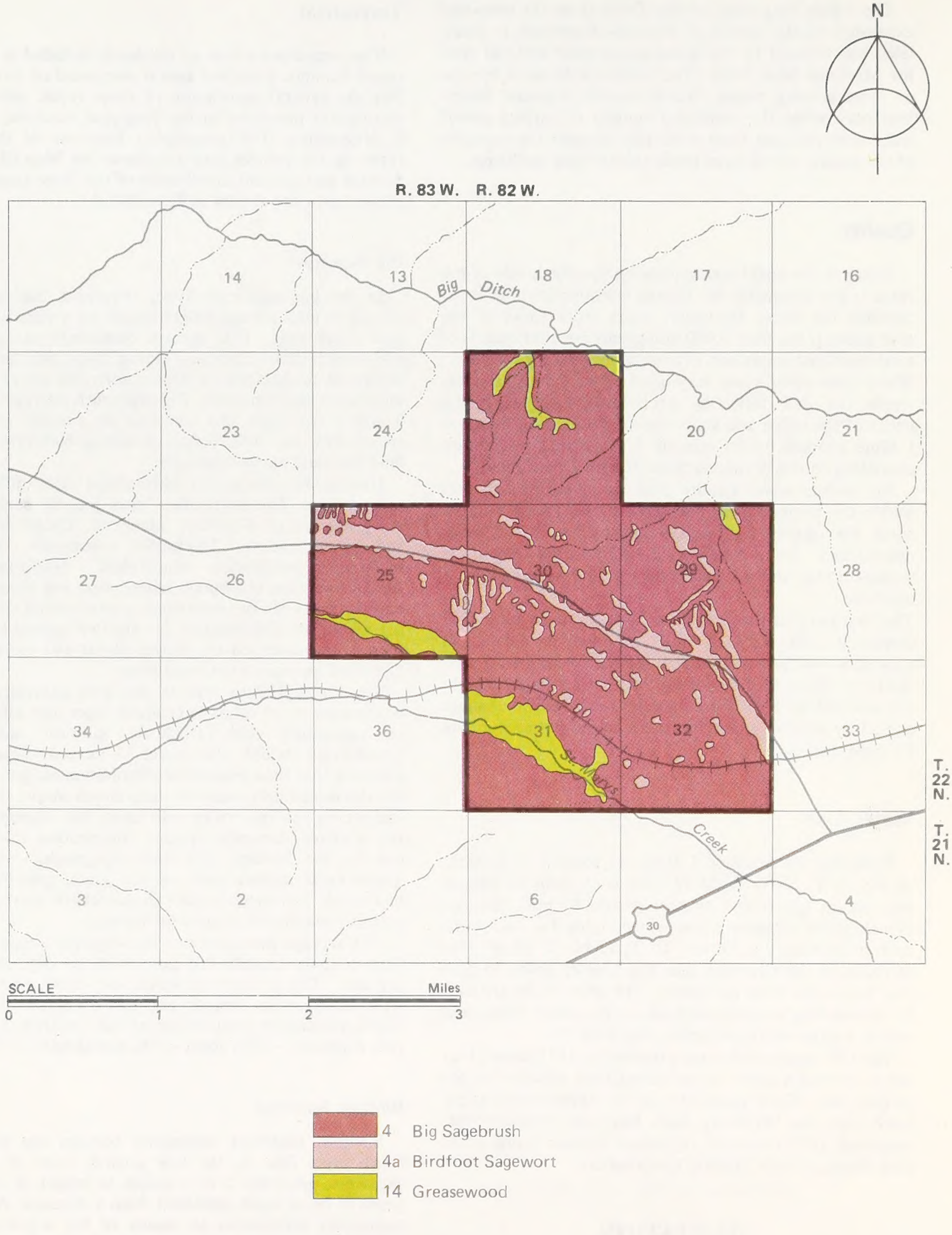
The big sagebrush type in this area generally occurs contiguous to all other vegetation types and often exists in association with shadscale saltbush and black greasewood, which also occur in pure or nearly pure stands within their respective distribution ranges.

On the moderately steep to steep slopes above the drainage where shallow rocky soils exist, the vegetative type has a mixed, irregular species composition that occurs due to the variable soil and topographic sequences. These areas include most of the grass, grasslike, forb, half-shrub, and shrub species characteristic to the big sagebrush and birdfoot sagewort types.

The average production of the vegetative type over all sites is approximately 808 pounds of air dry vegetation per acre. This production would vary from year to year with variances in climatic and soil moisture conditions. The approximate composition of this vegetative production is grasses—22%, forbs—1%, and shrubs—77%.

Birdfoot Sagewort

Birdfoot sagewort commonly borders the big sagebrush type. Due to the low growth form of birdfoot sagewort, generally 2 to 3 inches in height, it often appears to be an open grassland from a distance. Although commonly contiguous to stands of big sagebrush and shadescale saltbush, it is rarely found mixed or in association with the surrounding vegetation types.



Map SI 2-3

VEGETATIVE MAP
Seminoe I

Table SI2-3

VEGETATIVE DISTRIBUTION BY ACRES AND PERCENT ON PROJECT AREA

Type	Type No.	Vegetative Distribution Project Area Acres	Vegetative Distribution Project Area Percent
Sabebrush	4	3,133	81.6
Birdfoot Sagewort	4a	432	11.2
Greasewood	14	275	7.2
TOTAL		3,840	100.0

Dominant species within stands include birdfoot sagewort, thickspike wheatgrass, bottlebrush squirreltail, Sandberg bluegrass, Nuttall saltbush, and Hoods phlox.

Due to past use of the area, the vegetative production on this type is low and totals approximately 268 pounds of air dry vegetation per acre. The composition of this vegetative production is composed of grasses—44%, forbs—1%, and shrubs--55%.

Greasewood

This type is characterized by evenly dispersed plants from 2 to 4 feet in height. The type is generally confined to saline soils, usually in draws or bottoms where salts have accumulated as a result of surface runoff and evaporation. At a distance, the growth form and general appearance of the type can be confused by the big sagebrush type. Where saline or saline-alkaline conditions are not exceptionally high (near the head of drainages and along sides of the larger draws), greasewood occurs in association with big sagebrush. The greasewood type is commonly bordered by the big sagebrush type.

Understory species composition varies within the same drainage and from one drainage to another. The number of species is limited to those with a high tolerance to saline soil. Western wheatgrass, thickspike wheatgrass, and Sandberg bluegrass are dominant understory.

The average production of this vegetative type is approximately 870 pounds of air dry vegetation per acre and is composed of grasses—19%, forbs—1%, and shrubs—80%.

Production

The average production over the entire project area from all vegetative types is estimated to be approximately 755 pounds of air dry vegetation per acre composed of grasses— 24%, forbs—1%, and shrubs—75%.

Riparian

There is no riparian vegetation on the proposed project area.

Aquatic

Due to the intermittent characteristics of the drainages, there is no aquatic habitat on the project area.

Endangered and/or Threatened

There is no record of, nor did a field examination conducted during the spring of 1977 by Robert Dorn, BLM botanist reveal, the existence of any threatened or endangered plant species on the proposed Seminoe I project area. Due to the soil types that exist in the area, it was concluded that the chance of any threatened or endangered plants being present is near zero (refer to Regional, Chapter 2, Vegetation, Endangered and/or Threatened).

FISH AND WILDLIFE

General Information

Habitat Types

The primary habitat types that are found on the project area and the major species of wildlife that occur in these various types are listed below. A partial listing of wildlife species that could occur on the project site can be obtained from the Rawlins District Office of the BLM.

Aquatic

There is no adequate aquatic habitat available in the project area to support fish life. All streams in the area are intermittant or ephemeral. There are four stock reservoirs either in or immediately adjacent to the project area that furnish water for wildlife and domestic livestock during most of the summer, but the water supply for these reservoirs depends upon winter snows and summer rains and as a result, they do not furnish water year round.

Terrestrial

Sagebrush (3,133 acres). This vegetative type supports a great variety of wildlife species including pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, coyote, least chipmunk, Uinta ground squirrel, deer mouse, Great Basin pocket mouse, sage grouse, Brewer's sparrow, vesper sparrow, sage sparrow, sage thrasher, horned lark, and Brewer's blackbird.

Birdfoot Sagewort (432 acres). The various species of wildlife found in this vegetative type are much the same as those found in the sagebrush type. The major species found here are listed above in the sagebrush section.

Greasewood (275 acres). This vegetative habitat generally will support the following major species of wildlife; pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, coyote, Uinta ground squirrel, least chipmunk, deer mouse, sage thrasher, sage sparrow, Brewer's sparrow, horned lark, vesper sparrow, marsh hawk, red-tailed hawk and golden eagle.

Fishery

There are no fisheries existing on the proposed mine site.

Wildlife

Introduction

The primary vegetative types occurring on the project area are sagebrush (3,133 acres), birdfoot sagewort (432 acres) and greasewood (275 acres).

Birds

Nongame. The major small nongame bird species found on the project area are listed under various habitat types at the beginning of this section. There are about 43 species of small birds that could occur on the project area. The best available information from both literature and ornithologists indicates that there are an estimated 8 to 40 breeding pairs of small birds per 100 acres (personal communication, Max Schroeder, March 1978). The project area is used as both nesting and hunting habitat for several species of raptors. The most commonly observed species are golden eagle, Swainson's hawk, marsh hawk, red-tailed hawk, and American kestrel. One great horned owl nest has also been found on the project area. Nests of golden eagles, ferruginous hawks, and prairie falcons have also been identified on the area.

Game. The entire project area of 3,840 acres is classified by the Wyoming Game and Fish Department as year-round sage grouse habitat. There are no strutting grounds or leks located on the project area; however, there are 384 acres of critical nesting habitat on the site since there are two leks located adjacent to the project area to the southwest (see Map SI2-4).

Mammals

Nongame. According to sightings and a search of current literature (Burt and Grossenheider 1976; Wyoming Game and Fish Department 1977d), there are at least 21 species of small nongame rodents that could occur on the project area during some portion of the year. Some of the more common species are the deer mouse, lease chipmunk, Richardson's ground squirrel, and whitetail jackrabbit. The best density information presently available indicates that there are about 5 to 20 small mammal species per acre, averaged over the vegetative types found on the project area, consisting of about 10 to 100 individuals, or a total estimated density of from 50 to 200 small mammals per acre (personal communication, Dr. Jack Turner, January 1978).

Game. The pronghorn habitat on the project area is composed of big sagebrush and greasewood and is utilized as both winter and year-round range. Numbers of pronghorns on the site are not large due to adjacent mining activities, rarely exceeding ten animals. Numbers of these animals will fluctuate greatly because of seasonal movements into and out of the area. The small size of the project area precludes large numbers of pronghorns staying on the area for any length of time. Ranges of various terrestrial wildlife species can be found on Map SI2-4.

There is some marginal winter/year-round range for mule deer that is composed of greasewood and big sagebrush on the project area. Because of the marginal nature of the habitat and disturbances caused by adjacent mining activites, numbers of mule deer inhabiting the site are very low (four to six animals). The southeastern portion of the area is the poorest quality range for deer.

The desert cottontail rabbit is a very common small game mammal on the project area. The Wyoming Game and Fish Department (1977d) estimates that there are about five rabbits per acre in these vegetative types.

General. Reptile and amphibian numbers are low at best on the project area. Some of the species which could occur on the site are sagebrush lizards, northern shorthorned lizards, northern sideblotched lizard, and the western rattlesnake. There is little riparian vegetation and very little free water on the area which would provide habitat for any kind of amphibians.

Feral (Wild) Horses

Feral horses do not occur on the project area.

Endangered and/or Threatened

Since there is a whitetail prairie dog colony located on the project area, there is a possibility that the black-footed ferret could occur on site. There does not appear to be any possibility of other threatened or endangered mammal species occurring on site.

No endangered or threatened species of birds are known to exist on the proposed site. There is a possibility that the project area may be used by migrating bald eagles and peregrine falcons.

There are no known threatened or endangered fish, reptiles or amphibians known to exist on the proposed mine site.

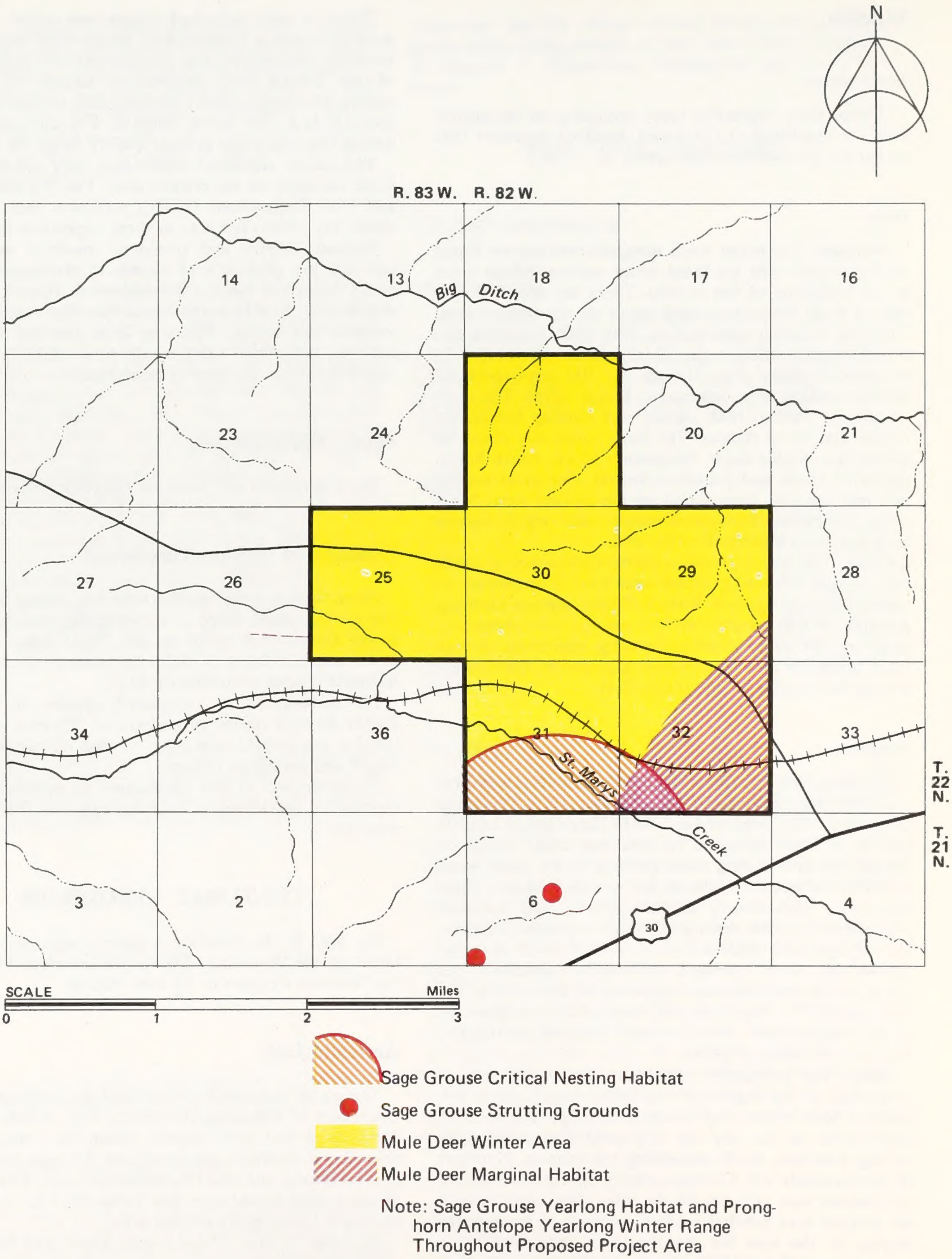
CULTURAL RESOURCES

No sites in the Seminoe I project area are currently listed on the Wyoming Historic Preservation Plan or on the National Register of Historic Places.

Archeological

The entire Seminoe I project area was surveyed by the University of Wyoming (1976 and 1977). Twenty-one archeological sites were located within the project boundaries for an average site density of 3.5 sites per section. One additional site was located outside, but within 1 mile of the project boundaries. See Table SI2-4 for a listing of site types found in the project area.

Of these 22 sites, 12 have been tested and completely evaluated. This testing program demonstrated that the available cultural information has been completely recov-



Map SI 2-4

WILDLIFE HABITAT
Seminoe I

Table SI2-4

CULTURAL RESOURCES

Site Type	Number of sites
Open Campsite	11
Stone Rings	9
Isolated firepit/firecracked rock	2

ered and that the sites are of no further significance. National Register eligibility of the 10 remaining sites would not be established until further testing is done. The State Historic Preservation Officer will be consulted to establish the significance of these sites.

The potential for subsurface sites also exists within the entire project area, particularly in areas of windblown or alluvial deposits.

Historical

No historical resources were located within the Seminoe I project area during the intensive cultural survey.

VISUAL RESOURCES

A visual resource classification was conducted by the Bureau of Land Management (BLM) on and adjacent to the project area illustrated on Map SI2-5. The classification was conducted using BLM visual resource inventory and evaluation procedures as explained in BLM Manual 6300.

The Visual Resource Management Class that has been identified within the project is a Class III (3,840 acres—100%).

The characteristic landscape (Figure SI2-2) of the project area is also typical of adjacent land. The land consists of low rolling terrain covered with sagebrush and mountain shrubs. No outstanding drainage features exist.

The project area is crossed by an improved dirt road, a few unimproved dirt roads, a rail spur, fences, and a power line. Also, the existing Seminoe I Mine is located adjacent to the proposed project area. These intrusions, generally seen from within the project area, reduce the value of the management class.

A portion of the project area is visible from U.S. Highway 30 which passes near by. The improved dirt road, which only serves the existing mine, and U.S. Highway 30 have high year-round use and are important to the visual sensitivity.

Management of the Class III area would require that changes in the basic elements (form, line, color, and texture) could be evident in the characteristic landscape; however, the changes should remain subordinate to the visual strength of the existing landscape character.

RECREATION RESOURCES

Visitor Use Data

Table SI2-5 depicts the estimated visitor use by activity in the proposed project area.

Hunting

During the summer, incidental hunting is limited to rodents. In late summer the hunting season begins to draw hunters to the field. This area supplies primarily a small sage grouse and antelope population for hunting purposes. Deer hunting is very limited.

Rabbit hunters travel to the area to pursue cottontails, normally after the big game and bird hunting seasons are over. This season lasts from early fall until the end of February.

Off-Road Vehicles

There are several mineral exploration and ranching associated roads located in the project area. These roads are used extensively by persons with four-wheel drive vehicles during the hunting season.

Wilderness Values

There are no roadless areas in or near the proposed project area with identified wilderness values which meet the criteria set in Section 603 of the Federal Lands Policy Act of 1976.

Sightseeing

Most of the sightseeing use in the area can be considered incidental as people travel along U.S. Highway 30.

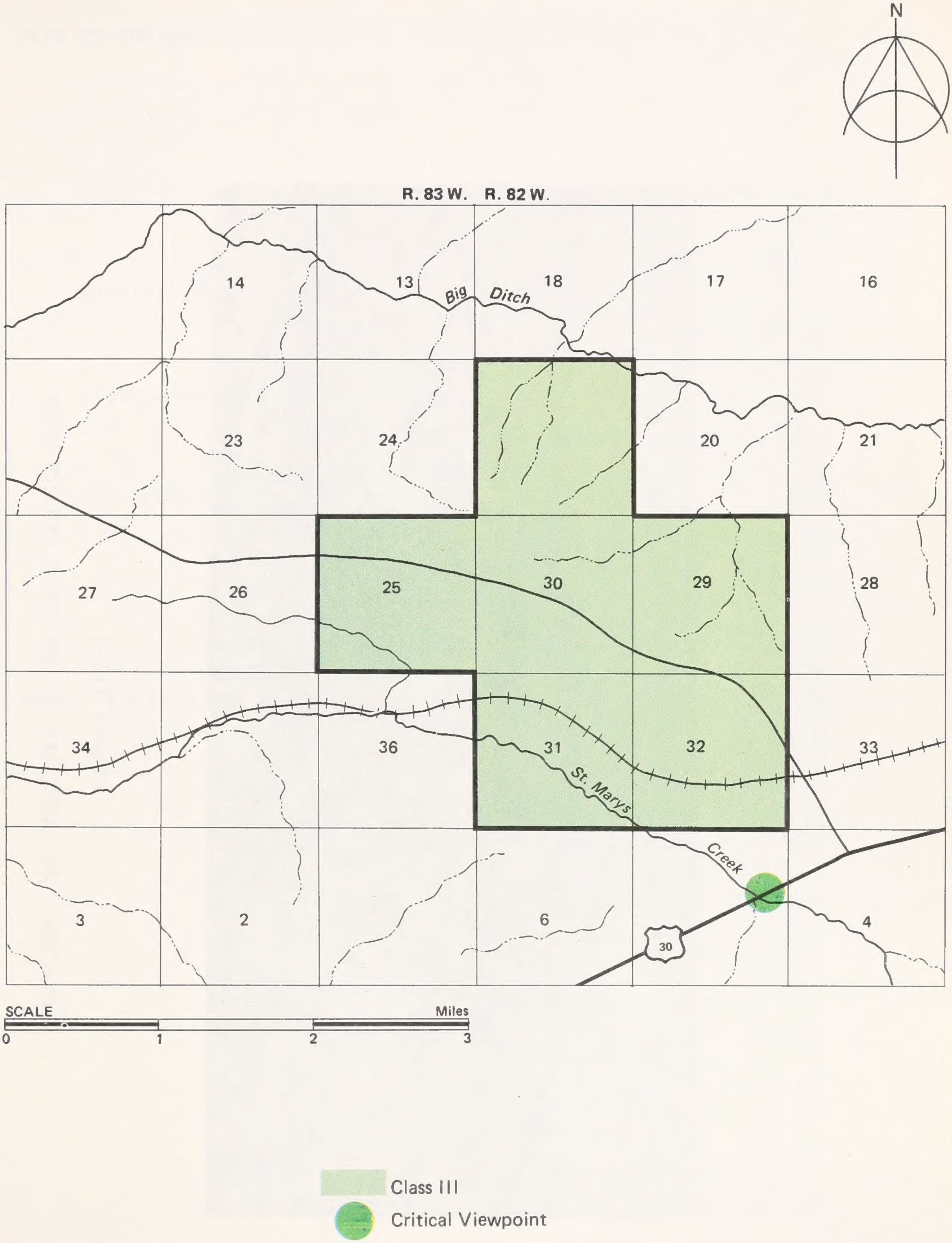
AGRICULTURE

Livestock Grazing

Seminoe I project area is located in the Quealy Block, Dana Meadows North, and Pass Creek Ridge allotments.

The Quealy Block allotment contains 54,262 acres and involves one ranch operation. Sheep graze the allotment under the yearlong management system for an annual use of 8,433 animal unit months (AUMs). Part of the project area covers 640 acres of the allotment, or approximately 1.2%, and has a grazing capacity of approximately 64 AUMs.

The Dana Meadows North allotment contains 66,633 acres and involves two ranch operations. Sheep graze the allotment under a yearlong management system for a yearly use of approximately 11,808 AUMs. Cattle graze the allotment during the spring, summer, and fall seasons for a yearly use of approximately 370 AUMs. Part of the project area covers 2,550 acres or approximately 3.8% of the allotment area, and has a grazing capacity of approximately 255 AUMs.



Map SI 2-5

VISUAL RESOURCES
Seminoe I

Figure SI2-2

CHARACTERISTIC LANDSCAPE OF SEMINOE I PROJECT AREA

Table SI2-5

1976 ESTIMATED VISITOR DAYS BY ACTIVITY IN THE SEMINOE I AREA

Activity	Visitor Days
Hunting (big game)	5
Sightseeing	275
Off-Road Vehicle	4
Total	284

Note: Visitor day considered to be 12 hours.

The Pass Creek Ridge allotment contains 59,558 acres and involves two ranch operations. Cattle are grazed on the allotment during the summer and fall seasons for a yearly use of 9,523 AUMs. Part of the project area covers 650 acres or approximately 1.1% of the allotment area. This allotment is located south of the main line of the railroad and is not included in the area to be mined.

Range improvements on the project area are limited. The only known fence on the project area is the 2 miles of fence along the boundary common to the Quealy Block and Dana Meadows North allotments. There are three stock water developments on the project area and one adjacent to it.

Farming

There is no cropland located within the proposed project area.

Alluvial Valleys and Prime Farmland

There are no alluvial valleys or prime farmland on the proposed project area.

MINERAL RESOURCES

Coal

The six seams of interest in the proposed mine expansion are in the Ferris Formation. From lower to upper, the seams are Lower Dana, Upper Dana, and Beds 21, 23, 24, and 25. Coal thickness and analyses are shown in Table SI2-6. Recoverable reserves are estimated at 5.2 million tons.

The coal is of subbituminous rank and averages 9,150 British thermal units (Btu) per pound and 0.7% sulfur.

Sand and Gravel

The nearest known deposits of sand and gravel are located west of the project area along the North Platte River (see Map 13 in Appendix A). Reserves or suitability for use as concrete aggregate are not known.

Scoria

The nearest known deposits of scoria are located north of Hanna on the Seminoe II and Rosebud Mines (see Map 13 in Appendix A). Reserves are not known.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

A large number of separate governmental agencies exercise certain types of land and resource use controls in Carbon County. The Seminoe I project area includes public and private lands. The federal sector includes the Bureau of Land Management (public lands and mineral estate under certain private lands). Development, management, use, and control of use on these public lands has been delegated to this agency.

Controls are effected through issuance or nonissuance of a variety of leases, permits, licenses, etc. Each authorization to use public lands contains provisions to control that use. Controls exercised by the federal government for the subsurface estate are governed by the statutes authorizing the disposition and use of that estate. Foremost among these statutes is the authority for leasing coal deposits and authority to require, as a condition of such leases, an operation-management plan and a reclamation-restoration plan. Management policy has been extended in greater detail by the National Environmental Policy Act of 1969, the Surface Mining Control and Reclamation Act of 1977, and the Federal Land Policy and Management Act of 1976. In certain situations, there is a joint or multiagency sharing of particular management and control functions and responsibilities, such as the cooperative agreement between the Department of the Interior and the state of Wyoming that allows the state to administer and enforce reclamation operations on federal leases in Wyoming. The subsurface estate vested in private or state ownership would normally be governed by applicable state of Wyoming statutes.

Under state of Wyoming statutes, the state is authorized to perform and administer certain surface land use, planning and development activities on state, county, municipal, and privately-owned properties. Two pieces of legislation passed by the 1975 Wyoming Legislature which could have a significant effect on land use are: The Wyoming State Land Use Planning Act and The Industrial Development Information and Siting Act. The Land Use Planning Act requires completion of county land use plans by 1978, and these plans could conflict with or modify some of the energy proposals. The Industrial Siting Act requires furnishing extensive information and a state permit before certain facilities can be constructed. The impacts of this act would affect developments which include gasification or electric generation proposals. Control does not apply to public properties except as provided by law.

Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands.

Under Wyoming statutes, counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture,

Table SI2-6

COAL THICKNESS AND ANALYSIS

Seam	Thickness (Feet)	Btu	Ash	Moisture	Sulfur
Lower Dana	4.5	9,435	13.50	15.25	0.70
Upper Dana	9.9	9,377	7.21	14.38	0.64
Bed 21	10.5	9,329	10.03	14.06	0.63
23	10.1	9,050	9.45	14.64	0.64
24	8.9	8,571	10.10	13.44	0.86
25	No Information Available				

industry, commerce, public use, and other purposes. The authority does not apply to any planning or zoning controls over lands used or occupied for the extraction or production of minerals.

Control over mineral uses is vested in the state of Wyoming under the Wyoming Environmental Quality Act of 1973. This act also authorized the state to control air quality, water quality, and solid waste management.

Where a county or city lacks a specific authority, provisions of the Wyoming Joint Powers Act are available to enable joint exercise of power, privilege, or authority. This legislation enables two or more agencies to jointly plan, create, finance, and operate (control) water, sewage, or solid waste facilities; fire protection agency facilities; transportation systems facilities; and public school facilities.

Carbon County has developed and adopted a comprehensive plan. Additionally, the county passed zoning ordinances to control land use. The Seminoe I project area is zoned for ranching, agriculture, and mining.

Cities have authority to effect a master plan, zoning, and other regulatory controls. Cities do not have statutory authority to effect controls over mineral extraction or production within their corporate limits. Furthermore, the Wyoming Environmental Quality Act of 1973 would preempt cities authority to regulate and control air, water, solid waste, and land quality standards except where specifically delegated to a municipality.

In summary, all of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

SOCIOECONOMICS

Demographics

Population

The 1977 population of Carbon County was 18,137. The population of Rawlins was 10,500; that of Saratoga was 2,050 and that of Hanna/Elmo was 1,500 (Table SI2-7).

Employment

Total Carbon County employment was 8,067 in 1977 (Table SI2-8). The 1977 unemployment rate for Carbon County was 3%.

Income

The total 1977 personal income (in constant 1977 dollars) in Carbon County was $147.1 million. The major contributors to this income were mining (28.4%), business services (19.7%), consumers services (13.5%), and construction (13.5%). Per capita personal income was $6,348 in 1975. Average weekly wages (Table SI2-9) have been the highest in the mining and manufacturing sectors of the economy.

Infrastructure

Private Sector

Total taxable sales in Carbon County were $67.5 million in 1977. Wholesale trade ($7.9 million), retail trade ($46.7 million), and services ($12.9 million) make up this total.

Local Government

Current (1977) assessed values, mill levies, and bonded indebtedness for the region are shown on Table SI2-10. The bond ceiling, which is the maximum amount of debt that a jurisdiction may incur, is based on the assessed value for the current year. Communities may not issue general revenue bonds for greater than 4% of assessed valuation and sewer bonds for an additional 4%. There is no bond ceiling for water bonds. Counties are limited to 2% of assessed value and school districts are limited to 10%.

Housing

There were 6,160 housing units in Carbon County in 1976, of which 16% were mobile homes. In 1977 there were 3,428 housing units in Rawlins. Of these, 20% were mobile homes (Table SI2-11).

Education

The 1977 school enrollment for District 01 (Rawlins, Sinclair, Baggs, Bairoil) was 2,668. Building capacity in District 01 is 3,368. The 1977 school enrollment for District 02 (Saratoga, Encampment, Hanna, Elk Mountain, Medicine Bow, Shirley Basin, McFadden) was 1,658. Building capacity in District 02 is 2,430 (Table SI2-12). The expenditures per average daily membership (ADM) in District 01 was $1,695 for 1976. In District 02, the expenditure per ADM was $2,554, while the statewide average expenditure per ADM was $1,721.

Health Care

In 1977 there were 2,015 people for each physician in Carbon County. The established standard is 1,000 population per physician. The standard for dentists is 1,600 population per dentist and for registered nurses it is 285 population per nurse. In Carbon County there were 2,591 people for each dentist and 263 for each registered nurse (Wyoming Department of Health and Social Services 1976, 1978).

Table SI2-7

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

Jurisdiction	1977 Population	Percent of Carbon County Population
Carbon County	18,137	100.0
Rawlins	10,500	57.9
Hanna/Elmo*	1,500	8.3
Elk Mountain	220	1.2
Medicine Bow	750	4.1
Saratoga	2,050	11.3
Encampment	500	2.8

* These towns are located several miles apart and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

Source: Water Resources Research Institute Economic Simulation Model, Water Resources Research Institute, University of Wyoming, March 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

Table SI2-8

EMPLOYMENT BY SECTOR - CARBON COUNTY*

Sector	1977 Employment	Percent of Total
Farm	526	6.5
Manufacturing	360	4.5
Mining	1,658	20.5
Construction	715	8.9
Government	919	11.4
Farm & Forest Processing	46	0.6
Railroads	480	6.0
Business Services	1,415	17.5
Consumer Services	1,948	24.1
Total Employment	8,067	100.0

Note: Employment figures shown represent the number of people living in Carbon County who are employed in one or more jobs. This corresponds to the definition of employment used by the U.S. Bureau of the Census.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, 1978.

Table SI2-9

AVERAGE WEEKLY WAGE BY NON-AGRICULTURAL SECTOR - CARBON COUNTY

Sector	Year 1970	1973	1974	1975	1976	1977	Average Annual Change (1970-76)**
Manufacturing	161.16	187.81	229.69	264.84	312.96	273.15	11.7
Mining	196.22	233.27	269.67	332.75	377.24	389.94	11.5
Contract Construction	139.55	204.38	221.39	241.05	245.85	255.16	9.9
Wholesale Trade	110.58	126.25	177.75	170.04	182.00	191.58	8.7
Retail Trade	70.08	72.96	93.18	114.21	113.44	115.99	8.4
Finance, Ins. & Real Estate	105.82	122.27	142.29	173.01	175.76	188.81	8.8
Trans., Comm., & Public Utilities	146.31	180.30	188.34	232.06	244.53	258.22	8.9
Services, includ. Agriculture, Forestry & Fisheries	65.40	80.33	86.57	98.96	106.30	124.05	8.4

* Based on monthly data for January 1977 through June 1977.

** This is the average annual rate of change (percent) between 1970 and 1976.

Sources: Wyoming Employment Security Commission, Administrative Services Division, Research and Analysis Section, Casper, Wyoming.

Table SI2-10

FINANCIAL CHARACTERISTICS
1977

Jurisdiction	Assessed Valuation	Mill Levy (per $1,000 assessed valuation)	Bonded Indebtedness
Carbon County	$188,630,804	$12.61	$ 159,100
Rawlins	14,505,124	14.76	2,993,000
Sinclair	4,721,591	8.00	none
Hanna	1,403,186	11.40	133,000
Elmo	96,963	12.26	144,000
Elk Mountain	202,399	13.00	27,000
Medicine Bow	621,144	8.00	40,000
Saratoga	2,584,955	8.00	282,000
Encampment	528,175	17.28	43,000

Sources: Assessed valuation, Mill Levy - Wyoming Taxpayers Association, Wyoming Property Tax Rates, 1977, Cheyenne, August, 1977.

Bonded indebtedness - Community budgets and/or phone conversation with town clerk.

Table SI2-11

HOUSING IN INCORPORATED AREAS
TOTAL AND BY TYPE
1977

		Type of Unit		
County Community	Total Year Round Units	Single Family	Multiple Family	Mobile Home
Carbon County				
Rawlins	3,428	2,034 (.60)	700 (.20)	694 (.20)
Hanna	510	325 (.64)	0 (.00)	185 (.36)
Elmo	77	35 (.45)	0 (.00)	42 (.55)
Elk Mountain	95	70 (.74)	0 (.00)	25 (.26)
Medicine Bow	246	100 (.41)	6 (.02)	140 (.57)
Saratoga	765	477 (.62)	87 (.11)	201 (.26)
Encampment	241	155 (.64)	2 (.01)	84 (.35)
Total Housing in Incorporated Areas	5,747	3,473 (.60)	795 (.14)	1,479 (.26)

Note: Figures in parentheses are the fraction of total housing units. These figures may not add to 100 due to rounding

Source: Except for the towns of Rawlins, Hanna and Medicine Bow, the data on housing has been taken from Land Use Plans submitted by the communities to the Carbon County Council of Governments in the fall of 1977. Although the figure on the total housing units in Rawlins was taken from a Land Use Plan, data on the type of housing was estimated from conversations with local officials. Housing figures for Hanna reflect estimates reported by the local town clerk. Total housing units for Medicine Bow reflect the results of a survey conducted by the local high school students in the spring of 1977. Figures on the type of units in Medicine Bow were estimated based on conversations with local officials.

Table SI2-12

PUBLIC SCHOOL CHARACTERISTICS

1977-78

School District School (Grade)	Student Enrollment	Full-Time Equivalent Teachers	Student/ Teacher Ratio	Building Design Capacity
School District #1				
Mountain View (K-6)	368	18	20.4	460
Pershing (K-6)	282	15	18.8	370
Sunnyside-Central (K-6)	465	14	33.2	488
Baggs-Morrow	213	16	13.3	275
Bairoil (K-8)	65	6	10.8	110
Sinclair (K-6)	65	3.5	18.6	140
Rawlins Jr. High (7-8)	387	22	17.6	525
Rawlins High (9-12)	823	47	17.5	1,000
School District #1 Total	2,668	141.5	18.8	3,368
School District #2				
Elk Mountain (K-6)	39	3	13.0	140
Encampment (K-12)	214	14	15.3	300
Hanna (K-6)	276	13	21.2	300
McFadden (K-8)	16	3	5.3	100
Medicine Bow (K-6)	114	7.5	15.2	150
Platte Valley (K-6)	275	16.5	16.6	300
Shirley Basin (K-6)	79	7.5	10.5	140
Beer Mug (1-6)	2	1	2.0	--
Hanna-Elk Mountain Junior-Senior High (7-12)	200	15	13.3	300
Medicine Bow-Shirley Basin Junior-Senior High (7-12)	153	13	11.7	400
Platte Valley Junior High (7-8)	91	6.5	14.0	300
Platte Valley High (9-12)	199	10	20.0	
District #2 Total	1,658	110	13.1	2,430
Carbon County Total	4,326	251.5	16.0	5,798

Sources: Wyoming State of, Department of Education, Division of Planning, Evaluation and Information Services, Fall Report of Staff/Teachers/ Pupils/Enrollments 1977, "Statistical Report Series, No. 2", 1977, Cheyenne, Wyoming.

Wyoming, State of, Department of Education, Communications Services, Wyoming Education Directory, 1977-78, Cheyenne, Wyoming, 1977.

Telephone conversations with Hugh Simmons, School Superintendent, District #1, March 22, 1978; and John Tynon, School Superintendent, District #2, March 22, 1978.

Local Services

The Carbon County Sheriff's office is currently adequately meeting demands and recent increases in workload (drug arrests increased 250% and number of prisioners handled increased 30% in the past year) are not resulting in decreases in the quality of service (Hansen 1978). A significant proportion of the Carbon County Volunteer Fire Department equipment dates from the 1940s and 1950s and is in need of replacement. The major inadequacy of the department is its inability to extinguish major fires requiring chemical or foam equipment.

The major problem with the Rawlins Police Department is inadequate facilities. The department is also considered understaffed and staff turnover because of high wages paid to miners adds to personnel problems (DeHerrera 1978). The largest potential problem in fire protection service in Rawlins is low pressure in the water system, particularly during the summer when demands for water peak. Rawlins' fire protection rating is seven which is considered adequate (Insurance Services Office 1978). Current improvements underway in Rawlins' water system are designed to meet water needs of the city until the year 2000 based on current growth rates (Paris 1978). Rawlins' present sewer system is being improved to correct major inadequacies. These improvements will significantly upgrade the system, however, the system will continue to have problems with old, undersized sewer lines that are overloaded and with groundwater seeping into older lines (Yamashiro 1978).

Turnover in the Hanna Police Department is an ongoing problem since those hired frequently quit to work in the mines. Hanna's fire protection rating is nine which is considered inadequate by the Insurance Services Office in Denver, CO. Hanna is currently improving its water system to meet current demands.

Elmo has no fire or police department. These services are provided by the town of Hanna and Carbon County. Elmo's water is supplied by Hanna. A 10,000 gallon storage tank has recently been built to solve the town's low water pressure problems.

Elk Mountain's fire protection rating is ten, which is considered inadequate (Insurance Services Office 1978). The town's water system is considered adequate only for present needs. Elk Mountain is the only incorporated area in the county which relies on septic tanks for sewage treatment. With the current population septic tank leachate is not considered a major problem.

Water service has been the most critical problem in the delivery of local services in Medicine Bow. By midsummer of 1978, current improvements to the water system should correct water supply problems. The towns' new sewage treatment lagoon is more than adequate to serve current needs. Medicine Bow's fire protection rating is nine, which is considered inadequate (Insurance Services Office 1978).

Saratoga is in the process of making improvements to its water and sewer systems. These improvements allowed the town to lift a 15-month moratorium on building caused by inadequacies in its water system. The town's sewage lagoon, however, cannot adequately treat the amount of sewage generated by the town and is currently operating at about 105% of capacity. Police and fire protection are adequate to meet the community's needs.

Water supply is a major problem in Encampment. Water shortages resulted in a building moratorium between July and October of 1977. Other local services are adequate or more than adequate to serve present needs.

Transportation and Utilities

Interstate 80, which is one of the principal interstate routes crossing the United States, is the most heavily traveled road.

A major Union Pacific railroad main line passes through southcentral Wyoming. In 1977, freight traffic through Rawlins averaged 50 trains per day carrying a wide variety of products between eastern and western markets. In addition, current coal production in the Hanna Basin added 42 trains per week (loaded and empty return) to transport coal to market.

Amtrak provides passenger railroad service from Rawlins east and west. There is one eastbound and one westbound train daily.

There are four airports in Carbon County. The Rawlins airport runway is paved with a length of 5,500 feet. The Saratoga airport runway is also paved with a length of 8,400 feet. Regularly scheduled air service is provided these airports by Trans Mountain Airlines. The other two airports, located just outside Hanna and Dixon, have unpaved runways and are used only by private planes (Donnelly Corporation 1978).

Interstate bus service is available on a daily basis. The bus depot in Rawlins is served by Continental Trailways, Greyhound, Central Wyoming Transportation, and Zanetti Bus and Fast Express (Russel's Railway and Motor Bus Company Guide 1977).

Carbon County is served by four electric utilities; Pacific Power and Light, Carbon Power and Light, Hot Springs REA, and Yampa Valley Electric.

Northern Gas and Mountain Fuel Supply Company distribute natural gas to the county.

Attitudes and Expectations

The attitudes reflected in this section were derived from the Hanna and Overland Planning Unit Planning Area Analyses and some limited opinion surveys that have been completed in the region.

General Attitudes

In 1975, T.A. Bougsty sampled opinion of residents in the Hanna Basin. This study, done for the Wyoming State Department of Economic Planning and Development, explored residents' preference on the size of their communities and satisfaction with various community services. It was found that 73% of the residents of Elk Mountain prefer no growth, while residents of Hanna

and Elmo would tolerate some growth. Satisfaction with community services varied somewhat between communities and the basin as a whole, with medical services, natural gas supply, streets and roads, community beautification, and recreation facilities the services residents were most dissatisfied with.

Information regarding the attitudes of residents in other areas of the Hanna Planning Unit is not presently available.

A resident survey covering the Overland Planning Unit was done in 1976 by Bickert, Browne, Coddington, and Associates. Among other things, residents were asked to rate adequacy of various community services. The results showed that only five services were rated 'very adequate' by 10% or more of the sample. These were fire protection, schools, utilities, roads and highways, and trash disposal.

Specific Attitudes

The following attitudes were derived from material contained in the Overland and Hanna Planning Area Analyses:

1. Forest Management: The timber industry, including the Wyoming Wood Producers Association, supports a continued timber sale program: large sales are desired.
2. Access: Hunting and recreation groups strongly support a program to obtain access in checkerboard land areas and other areas where private lands block access to public lands. Groups such as the Carbon County Conservation Club and the Wyoming Game and Fish Department support programs to obtain access.
3. Livestock organizations support a freeze or cutback of grazing fees on public lands. Most operators desire to have increased flexibility with respect to use of grazing allotments, in terms of class of stock, numbers of stock, season of use, etc. Most operators favor predator control and strongly favor management of wild horses and return of wild horse numbers to 1971 levels.

Lifestyles

The ongoing change in the lifestyles of the population residing in the areas associated with the Seminoe I project are the same as those occurring in the region as a whole. Please refer to the Regional, Chapter 2, Lifestyles for a complete description of these changes.

FUTURE ENVIRONMENT

The future environment on the 3,840 acres of the proposed Seminoe I project area, without approval of the mining and reclamation plan, would be essentially the same as it is today. Resources such as air, water, and visual qualities would be the same as today. The vegetative and soils resources would be unchanged, and wildlife and livestock populations would be near present day levels.

The general recreation uses in the area around the town of Hanna, which includes the project area, would increase as the population of Carbon County increases. The increase in use would result in a lower quality recreation experience and an increase of access restrictions to private lands.

The population in those portions of the region that would be impacted by the Seminoe I project would increase dramatically even without the project. The population of Carbon County would increase 43% to a total of 25,903 by 1985. Rawlins would increase 61%, Hanna/Elmo would increase 42%, and Saratoga would increase 20%. Employment, income, housing demand, school-age populations, etc., would increase in a like manner through 1985.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

ASSUMPTIONS AND GUIDELINES

The analysis developed in this chapter is an assessment of impacts that would result from the development of coal on the Seminoe I project. Impacts are quantified by time periods of 1980, and 1983 which is the end of mine life. Quantification may be stated as an increment for the time period or as a cumulative total at the end of each time period. The method that best quantifies the impact will be used. The following narrative and tables were developed to establish assumptions and guidelines for analysis of the proposed Seminoe I project.

Assumptions

Complete data on reclamation success in the southcentral region are not available. Preliminary success, based on observations of seedings on reclaimed areas less than 4 years old, has been minimal and in some cases a total failure. These minimal results are attributed primarily to climatic conditions (low precipitation, low humidity, strong winds, etc.); also to the method of handling overburden, parting material, and topsoil and to the minimal use of seed mixture, contour furrowing, and mulching (see Regional, Chapter 2, Vegetation).

Based on field observations of other reclaimed areas such as roadside cuts and fills, barrow areas, etc., it is estimated that reclamation would occur as outlined in items 2 and 3 that follow. This assumes that all mitigating measures as proposed in the reclamation plan would be applied. The mitigating measures outlined in the reclamation plan are proposed under the regulations that existed prior to SMCRA. The reclamation success anticipated with the application of the SMCRA regulations is discussed in Chapter 4.

Guidelines

1. Impacts are analyzed for two time points (1980 and 1983 which is the end of mine life).

2. Preliminary reclamation on an area is considered complete when disturbed lands have been backfilled, graded, contoured, and seeded. Complete reclamation of an area will require an average of 7½ years or more; 3 years for filling, shaping, contouring, seedbed preparation, and seeding; 4½ or more years for establishment of vegetative cover in accordance with an approved mining and reclamation plan (Wyoming Land Quality Rules and Regulations 1975).

3. Reclamation of land as proposed in the reclamation plan would take place on the following sequence and result in a vegetative cover suitable for cattle grazing.

1st year—shaping (filling and contouring)
2nd year—reshaping, topsoiling, and mulching
3rd year—seedbed preparation and seeding (fall)
4th year—rest for seedling establishment
5th year—rest for plant vigor, and reseeding of failure areas
6th year—rest for plant vigor, and seedling establishment
7th year—rest for plant vigor
8th year—defer first half of grazing season, graze lightly during last half

Tables SI3-1 and SI3-2 are presented to provide an overview of total land disturbance that would occur by the development of the Seminoe I project. Table SI3-1 portrays the acres of land disturbed and reclaimed during each designated time period by various activities related to the project. Table SI3-2 portrays the disturbance and reclamation of the same acreage as cumulative total for each time period by activities. Table SI3-3 presents a summary of impacts.

AIR QUALITY

Emissions from the Proposed Mine

Mining activities at the proposed Seminoe I Mine site would generate certain quantities of fugitive dust emissions. As a result, there would likely be a change in the total suspended particulate (TSP) concentration at the mine site and in surrounding areas. In order to determine the magnitude of such changes, it is necessary to identify the sources of fugitive dust emissions at the mine site, quantify the emissions from each source, locate the source within the proposed mining activity, and subsequently interpret the resultant air quality.

Ten major sources of fugitive dust have been identified at the proposed facility: haul road traffic, dragline, blasting, drilling, truck dump, topsoil removal, front-end loading, access road traffic, and wind erosion from exposed areas and coal piles. Two point sources identified were coal crushing and train loading. Table SI3-4 lists these emission sources and the corresponding emission factors. The annual emissions from the proposed site

Table SI3-1

ACREAGE DISTURBED BY ACTIVITY AND ACREAGE RECLAIMED
OVER PERIODS OF TIME
(NONCUMULATIVE)

Activity	Time Periods		Total
	1983	1983	
Final Contour	502	903	1,405
Mine Facilities	41	9	50
Ancillary Facilities	5	0	5
Subtotal	548	912	1,460
Population	20	0	20
Total	568	912	1,480
Acres Reclaimed	6	858	864*

*The remainining 571 acres of the 1,435 acres to be reclaimed would be reclaimed after 1983. Estimated completion date for reclamation is December, 1985.

Source: BLM 1978

Table SI3-2

ACREAGE DISTURBED BY ACTIVITY AND ACREAGE RECLAIMED
OVER PERIODS OF TIME
(CUMULATIVE)

Activity	Time Periods 1980	1983
Final Contour	502	1,405
Mine Facilities	41	50
Ancillary Facilities	5	5
Subtotal	548	1,460
Population	20	20
Total	568	1,480
Acreage Reclaimed	6	864*

*The remaining 571 acres of the 1,435 acres to be reclaimed would be reclaimed after 1983. Estimated completion date for reclamation is December, 1985.

Source: BLM 1978

Table SI3-3

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Climate	None	N/A*
Air Quality		
AQ-1	Generation of fugitive emissions would cause an increase in TSP concentrations at the mine and closely surrounding areas	N/A
AQ-2	Visibility would be reduced at and near the mine site	N/A
AQ-3	Slight amounts of NO_2, SO_2, and HC would be generated by mine vehicles	N/A
Geology	None	N/A
Paleontology		
GE-1	Loss of paleontological resources	N/A
Topography		
TO-1	Alteration of existing features and drainages	Yes - 30 CFR 715.14
TO-2	Lower elevation due to compaction of backfill	No - 30 CFR 715.14(d)
Soils		
SO-1	Destruction of established soil profiles on 1,460 acres	N/A
SO-2	Loss of productivity on 1,460 acres	Yes - 30 CFR 715.16
SO-3	Increased soil loss by wind (0.42 ton-acre-year) and water (2.4-5.0 ton-acre-year) erosion on unprotected areas (1,435 acres)	Yes - 30 CFR 715.13, 715.14
SO-4	Fugitive dust (soil loss) form mining activities	N/A
SO-5	Increased wind and water erosion on topsoil stockpiles and overburden spoil piles	Yes - 30 CFR 715.14, 715.16(a), 715.16(c)
SO-6	Continuation of contamination of soil around mine facilities	Yes - 30 CFR 715.14(j)
SO-7	Alteration of topography, slopes, and drainage patterns; resulting in increased erosion	Yes - 30 CFR 715.14 715.14(i)
SO-8	Exposure of material toxic to revegetative efforts	Yes - 30 CFR 715.14(j)

* Not applicable--that is, no provisions of SMCRA apply directly to the specific impact

Table SI3-3
(Continued)

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Water Resources		
WR-1	Lowered water level in a well near the mine	No
WR-2	Destruction of one stock reservir	No - 30 CFR 715.17
WR-3	Increased water use	N/A
Vegetation		
VG-1	Loss of native vegetative cover on 1,460 acres	N/A
VG-2	Reclamation would result in conversion of vegetative types for long term (40 to 50 years)	Yes - 30 CFR 715.13(a), 715.20(a)
VG-3	Grazing of young plants on reclaimed area would delay establishment of vegetative cover	Yes - 30 CFR 715.13(a), 715.13(a)
VG-4	Control of haul road dust and fugitive coal dust that could reduce palatability of affected vegetation for mine life would be 50% effective	N/A
VG-5	Noxious weeds could invade onto the disturbed and reclaimed areas	N/A
VG-6	Loss of native vegetation on 20 acres utilized in housing and support service sites	N/A
VG-7	Vegetative productivity level on reclaimed lands is expected to be 565 pounds air dry vegetation per acre as compared to 752 on premined acreage	Yes - 30 CFR 715.13a, 715.20(a)
Fish and Wildlife		
WL-1	Direct loss of 1,460 acres of wildlife habitat for 40 to 50 years	Yes - 30 CFR 715.13(a) 715.20(e)
1a	Loss of an unquantifiable number of small nongame birds on 1,460 acres.	
1b	Loss of 574 sage grouse on 384 acres	
1c	Loss an unquantifiable number of small nongame ron 1,460 acres	
1d	Loss of an unquantifiable number of cottontail rabbits on 1,460 acres	
1e	Loss of an unquantificable number of reptiles on 1,460 acres	
Cultural Resources		
CR-1	Possible destruction of subsurface archeological sites	N/A
Visual Resources		
VR-1	Destruction of existing landscape	N/A

Table SI3-3
(Continued)

SUMMARY OF IMPACTS

Resource and Impact Number Number	Impact Description	Impact Exceeds Allowances of SMCRA Regulations
Recreation Resources		
RE-1	Loss of recreation visitor days; especially for hunting purposes	N/A
Agriculture		
AG-1	Loss of suitability of range for sheep grazing on 1,460 acres for 40 to 50 years	Yes - 30 CFR 715.13(a) 715.20(a)
1a	Loss of 5,480 animal unit months of grazing during mining and reclamation	N/A
AG-2	Loss of use of one stockwater pond destroyed or rendered useless by by mining	No - 30 CFR 715.13(a) 715.20(c) 715.17(I)
Mineral Resources		
MR-1	Loss of mineral resources (coal, sand, gravel, scoria) through mining and mine-related uses	N/A
Socioeconomics		
SE-1	Regional Population increase of 91 by 1985	N/A
SE-2	Employment increase of 39 by 1985	N/A
SE-3	Total annual earnings increase of $1.2 million by 1985	N/A
SE-4	Additional housing demand of 77 units (19 single family) by 1985	N/A
SE-5	School District #1 school-age population increase of 11 by 1985. School District #2 school-age population increase of 11 by 1985.	N/A
SE-6	Worsened population per health care specialist ratios	N/A
SE-7	$0.5 million increase in retail and wholesale sales	N/A
SE-8	Increased pressures on local services (water, sewer, police, fire protection, solid waste)	N/A
SE-9	Increased congestion on access roads especially during shift changes	N/A
SE-10	Increase work-related injuries and illness by 1.3 cases per year	N/A
SE-11	Increase work-related fatalities or debilitating injuries an unquantifiable amount	N/A

Table SI3-4

FUGITIVE AND POINT SOURCES IDENTIFIED AT THE PROPOSED FACILITY WITH CORRESPONDING EMISSION FACTORS*

Emission Source	Emission Factor
Fugitive:	
1. Haul Roads	13.6 lb/vehicle mile traveled
2. Blasting	
a. Coal	72.4 lb/blast
b. Overburden	85.3 lb/blast
3. Truck Dumping	
a. Coal	0.007 lb/ton dumped
b. Overburden	0.002 lb/ton dumped
4. Drilling	
a. Coal	0.22 lb/hole
b. Overburden	1.5 lb/hole
5. Topsoil Removal	
a. Scraping	0.35 lb/yd^3 scraped
b. Dumping	0.03 lb/yd^3 dumped
6. Front-End Loading	
a. Coal	0.12 lb/ton loaded
b. Overburden	0.12 lb/ton loaded
7. Access Road Traffic	5.11 lb/vehicle mile traveled**
8. Exposed Areas (Wind Erosion)	0.42 ton/acre-year***
9. Dragline	0.0002 lb/ton overburden handled
10. Coal stockpile	8.64 lb/acre-hour
Point Sources:	-
1. Crushing	2 lb/ton crushed
2. Train Loading	0.0002 lb/ton loaded

*Emission factors from PEDCo Environmental, Inc. 1978 except as noted.
**Calculated from formula in U.S. Environmental Protection Agency 1975.
***Calculated from formula in Midwest Research Institute 1974.

were calculated using the emission factors listed in the table. The operational parameters were obtained from the mining and reclamation plan.

Emission inventories were performed for the mining years of 1980 and 1983 which is the last active year of mining. These inventories are the best approximations of the complex interaction of variables. Table SI3-5 presents the annual emissions from each source for the designated years.

Best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plan on file with GS in December, 1977 were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

The gaseous air pollution sources would be exhaust emissions from diesel-powered haul trucks and employee motor vehicles. Emission factors for vehicular travel were obtained from EPA's most recent compilation of mobile source emission factors and reflect current legislation relative to future emission standards in high altitude areas (EPA 1978).

Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur dioxide (SO_x) are shown in Table SI3-6. These emissions are from both employee travel on the mine site and haul trucks.

Impact on Air Quality

The proposed Seminoe I action calls for a 4 year life span expansion of the Seminoe I Mine which has been operating since 1972. Presently, the Seminoe I Mine is producing 2.3 million tons per year. At the present mining rate, production will fall to 1.0 tons per year in 1979. The purpose of the proposed action is to pick up the slack in order that Seminoe I can continue its present production rate (2.3 million tons/year) until 1983. Since the production rate is to remain constant, the emissions now generated by the mining activity would also. Therefore there would be no additional impact on air quality, other than what exists at the present. Present impact is reflected in the existing ambient particulate concentration of 31 micrograms per cubic meter ($\mu g/m^3$) with maximum 24-hour concentrations of 86 and 71 $\mu g/m^3$. None of these values exceeds the annual or 24-hour maximum Wyoming state standards.

The same also is true for gaseous pollutants. Ambient levels of CO, HC, NO_2, and SO_2 are expected to remain at their extremely low levels.

Visibility is expected to average 26 to 47 miles depending upon climatological conditions. During worst case TSP conditions, visibility may be expected to decrease to about 12 miles because of fugitive dust emissions, however this occurrence would be infrequent.

GEOLOGY

The proposed action would not significantly impact the geology in the project area. The potential for coal fires would be increased by exposure of the unweathered coal containing volatile materials.

Paleontology

Impact to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses of various degrees would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

Fossil materials of Lower Paleocene/Upper Cretaceous and Miocene age in the Ferris and North Park Formations would be impacted to an undetermined extent.

All exposed fossilferous formations within the area could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased regional population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

TOPOGRAPHY

Temporary unnatural steep slopes in the pit and on spoils would result from the stripping operation. Natural drainages would be diverted or altered. After reclamation, there would be a slightly different contour to the land than previously existed. After restoration, the average elevation of the mined area should be temporarily about the same as present, because the expansion of the disturbed overburden should about compensate for the coal removal. However, the backfill would recompact over the years. Areas where steeply dipping or multiple coal seams have been mined would ultimately have a lower average elevation by about 20 feet due to compaction of backfill.

SOILS

Surface mining (final contour acreage) at the Seminoe I Mine project would cause soil disturbance cumulatively on 502 acres by 1980 and 1,405 acres by 1983 (end of mine life).

The construction of a power line (115-kv) and, relocation of access road and telephone lines would cumulatively disturb 41 acres by 1980 and 50 acres by 1983.

Table SI3-5

ANNUAL EMISSIONS FROM EACH MAJOR SOURCE FOR EACH STUDY YEAR

Emission Source	TONS PER YEAR 1980	1983*
1. Haul Roads (with watering)	660	707
2. Blasting	22	23
3. Truck Dumping	5	5
4. Drilling	21	26
5. Topsoil Removal	230	0
6. Front-End Loading	97	97
7. Access Roads	85	85
8. Exposed Areas (wind erosion)	355	271
9. Dragline	443	443
10. Coal stockpile	15	15
11. Train Loading	<1	<1
12. Crushing	13	13
Total	1,946	1,685

* Last active year of mining.

Table SI3-6

EMISSIONS OF GASEOUS POLLUTANTS FROM VEHICLES AT THE PROPOSED SEMINOE I MINE SITE

Year	Total emissions, ton/yr CO	HC	NO_x	SO_x
1980	13.8	2.0	5.3	1.3
1983	18.9	2.7	7.4	1.8

Construction of ancillary facilities would cumulatively disturb 5 acres by 1980. No further construction disturbance of surface soils is expected after 1983.

Mining and other related activities would impact soils by alteration of existing soil characteristics and properties. These include soil microorganism composition, structure, textures, organic matter content, infiltration rates, permeability, water holding capacities, nutrient levels, soil-climatic relationships, and productivity levels that have developed over geologic time (Brady 1974; BLM 1975a; Bay 1976). The established levels of soil productivity (see Table SI3-7) would be lost for the period from disturbance until reclamation is successful.

Reclamation (shaped, seedbed prepared, and initial seeding) of surface mining and associated ancillary facility areas would cumulatively occur on an estimated 6 acres by 1980 and 1,435 acres by 1985, (refer to Vegetation, Chapter 3 for further information). Depths of suitable topsoil material, slopes, aspect, surface manipulations, and climate (precipitation) are important variables of reclamation success. Some of these factors would influence erosion rates and losses in soil productivity on reclaimed areas (Monsen 1975; BLM 1975a; May et al. 1971).

The soil productivity levels on 1,435 acres would be reclaimed, but not to premining levels. At the time of initial seeding and vegetative establishment, the post-mining soil productivity over most of the project would be an estimated 50% of the post-mining potential (see Figure SI3-1). The post-mining potential would be an estimated 75% of the average premining productivity (400 to 1,000 pounds air dry weight vegetation per acre per year). The productivity levels would increase during the 40 to 50 years after the start of reclamation. As this occurs, potential soil productivity levels which are approximately 75% of the premining productivity levels would be attained due to proper management and increased microbial interactions. Physical and chemical changes in these new soils would also be initiated.

The lack of suitable soil material, aspect, and slopes as well as areas poor for reclamation are evident on the Seminoe I project in mapping units 252 and 254. The disturbance of these soils (in 252 and 254) could lead to an improvement in soil productivity on approximately 384 acres, since soil depths, slopes, and subsoil alkalinity (254) would be altered.

Mining would involve the excavation and storage of topsoil (13 acres) and the storage (659 acres) of usable and unusable overburden material. Increased wind and water erosion would occur from stockpiled materials. Mining activities would also increase soil loss from increased fugitive dust levels, especially haul road dust (see Air Quality, Chapter 3, Table SI3-4).

Mining would expose materials in the Ferris formation that could hamper reclamation. These could include overburden and parting material with high alkalinity (SAR) or salinity (E.C.), low or high pH, sand or clay materials, or other materials (see Table SI3-8). The overburden analyses of test holes OB3530, 2408, 3860, 5, and 3894 shows extensive amounts of overburden and parting material unsuitable for reclamation use (see Map SI1-4). This extensive unsuitable overburden and parting material with the exception of that in OB5 (19 to 252 feet) occurs below 100 feet. The soil survey (MRC 1976d; USDA, SCS 1978) over the Seminoe I amendment area shows a moderate or high accumulation of salinity in subsoil (below 9 inches) in mapping unit 254 (Bullock series—45%). The high salinity levels would make Bullock soils unsuitable for topsoil reclamation material.

The exposure, compaction, burial, stockpiling, disturbance, and contamination of surface soil would cause reductions in the current levels of soil productivity and increase soil loss from wind and water erosion. The stockpiling of surface soil would degrade the biological, chemical, and physical properties, causing temporary reductions in productivity when used as reclamation topsoil material (Monsen 1975; BLM 1975a; Singleton and Cline 1976). Accidental spills of oil, gasoline, and other toxic materials would contaminate soil profiles, especially around mine facilities. This spillage would contaminate and sterilize soil horizons, rendering the affected soil permanently unusable for reclamation.

All of the mining disturbances would result in accelerated erosion by wind and water upon presently existing soils, soil material, and overburden spoilpiles, due to exposure and increased activity (Monsen 1975). Wind action, which is fairly constant over the area, would cause fine particles to be lifted from the exposed surfaces and blown away. Wind erosion from the exposed areas, before reclamation, would be an estimated 0.42 tons/acre/year (see Air Quality, Chapter 3, Table SI3-5). Prior to revegetation of exposed, disturbed, and stockpiled soils, high intensity storms (possibly occurring about 1 year in 10, to 1 year in 25 years and usually in late May or June) could lead to increased water erosion (Lowham 1976; Becker and Alyea 1964). The increased erosion would result from the disturbed soils not having any protective cover and the reduction of soil infiltration rates (resulting from compaction and steep slopes) causing increased runoff (Dollhopf et al. 1977). The erosional rates over the final contour areas prior to revegetation would be an estimated 2.4 to 5.0 tons/acre/year.

Alterations of soil horizons due to mining, culverts, drainage ditches, diversions, and changes in topography (slope) could increase flow velocities from unprotected surfaces and could accelerate sheet, rill, and gully erosion. The area of concern would be on reclaimed areas where loss of protective ground cover would subject surfaces to increased erosion (see Water Resources, Chapter 3).

Mine-related population increases and the associated housing and urban support facilities would cumulatively remove from productivity 20 acres by 1980.

All developments (surface mining, mine facilities, ancillary construction, and mine associated increased population needs) would cumulatively disturb soils on 568 acres by 1980 and 1,480 acres by 1983.

The 45 acres used for population needs and access road would be utilization of soil resource for an alternate purpose. The 1,455 acres disturbed by mining and mine facility construction would be approximately 37.9% of the project area.

Table SI3-7

ACRES DISTURBED AND SOIL PRODUCTIVITY

MAPPING UNIT #*	SOIL ASSOICIATION**	ACRES DISTURBED***	VOLUME OF SOIL****	SOIL PRODUCTIVITY*****
90B	Blazon loam (85%)	2	0-1,600	425-638
210	Ravalli (30%)--Forelle (30%)--#15 (25%)	3	5,600-24,200	475-735
251	Grieves (55%)--Blackhall (30%)	---	---	595-939
252	Shinbara (35%)--Blazon (30%)--Rock Outcrop (25%)	154	0-82,800	238-374
253	Blazon (40%)--Satanka (35%)	589	475,000-2,138,000	410-685
254	Bullock (45%)--Blazon (35%)	230	185,000-308,000	464-514
256	McFadden ( )--Rock River ( )	---	---	525-900
257	Harve--Glendive (85%)	---	---	1,360-1,955
258	Rock River (45%)--Satanka (35%)	427	978,000-3,444,000	525-925
260	Ryan Park (45%)--Rock River (30%)	---	---	525-900

*Map reference numbers refer to Soils Map SI2-1
**Soil Series and percent making up soil associations: minor soils comprising a part of a soil association are not listed in this table; therefore, the composition does not total 100% for each soil association.
***Acres disturbed by soil association in final contour acreage.
****Estimated amounts of topsoil material available for reclamation in cubic yards, based upon final contour acreage disturbed and inches available for use in soil associations.
*****Soil productivity of soil associations (pounds air dry weight vegetative per acre per year--SCS production data). Additional minor soils in association not included in calculations.

Sources: U.S. Department of Agriculture, SCS 1978.

WATER RESOURCES

Groundwater

No significant impact on groundwater is anticipated from the proposed mine. Some minor aquifers would be intercepted, but the quantity of water that would drain from them would be of only local significance. The flow to two wells at the existing Energy Development Company Vanguard Mine could possibly be reduced.

The amount of water used for mine operation would remain at the present level. The population increase caused by the expansion would increase the regional municipal use by 20 acre feet per year, or less than 0.1%, through about 1989.

Surface Water

Drainage patterns and runoff characteristics would be altered on about twelve first order ephemeral streams, the largest of which drains about 120 acres, and one second order stream. One stockwater reservoir could be destroyed or rendered useless, but the company would be required to provide a replacement source to comply with SMCRA. Replacing the reservoir would eliminate the impact.

Quality

Because of the small quantity of runoff and recharge and limited occurrence of groundwater at the site, it is unlikely that the proposed expansion would harm the water quality either above or below the land surface.

VEGETATION

Terrestrial

The disturbance of the vegetative resources on the Seminoe I project area would begin in 1979. The acreage of vegetation that would be disturbed by this project is shown in Tables SI3-1 and SI3-2. The acreage of each vegetative type that would be disturbed by mine development is shown in Table SI3-9 by time period.

Since the basic mine and ancillary facilities are presently in place, the vegetative disturbance would be confined to that done by expansion of mining, additional haul road construction, feeder power lines, and the relocation of 3.5 miles of access road. The cumulative acreage that would be disturbed by these expanded activities would be 502 acres by 1980 and 1,460 acres by 1983 which is the end of the mine life.

Population increases associated with the expansion would cause destruction of vegetation on additional acreage at various population centers of the region for housing and support service sites. The acreage of vegetation that would be disturbed for this purpose would be 20 acres by 1980.

The total vegetative disturbance that is expected would be: 1979 to 1980—548 acres and 1981 to 1983—912 acres. The cumulative acreage disturbed by like time periods would be 548 and 1,460 acres, respectively.

Since mining would be progressive from the existing mine onto the expansion area, the rate of mining would be rather constant at approximatley 365 acres yearly. The maximum acreage of land that would be in an unreclaimed state is expected to be approximately 875 acres which would occur at approximately mid 1983.

The cumulative acreage of the mine area that would be reclaimed (shaped, seedbed prepared, and seeded) would be 6 acres by 1980; 560 acres by 1983; and 1,435 acres by 1985. The 25 acres utilized in the development of the access road would not be reclaimed since the road would be retained to replace the road that presently crosses the area proposed to be mined.

With the assumption that reclamation would be conducted as proposed in the reclamation plan and that revegetation would occur in the sequence as outlined in the guideline section, the following is a description of vegetation establishment that is expected to occur.

Vegetative type conversion to grassland from the big sagebrush and birdfoot sagewort types is likely to occur on the reclaimed areas since it would be difficult to reestablish the plant species indigenous to the area by the seeding method. The replacement of only a minimal depth of topsoil and the expected alteration of soil structure and microclimate environment would not permit vegetative production to premining level nor be conducive to production of present plant species and composition during the life of the mine. The ultimate vegetative production capability of the reclaimed lands is expected to average approximately 565 pounds of air dry vegetation per acre. At the initial seeding, the soil productivity is expected to be approximately 50% of post-mining potential and vegetative establishment approximately 65% successful (see Figure SI3-1). This would result in a vegetative production of approximately 166 pounds per acre. Subsequent spot seeding, improvement of soil conditions, and further establishment of vegetative cover through resting the area would result in a vegetative production of approximately 413 pounds per acre with an estimated composition of 85% grasses, 10% forbs, and 5% shrubs at the end of the 7½ year reclamation guideline outlined at the beginning of this chapter. At this point, adequate forage would be available for cattle grazing even though vegetative production would be considerably lower than the 755 pounds of air dry vegetation produced per acre before mining. This would be attainable since the reestablished vegetation is expected to have a composition of 85% grasses as compared to 24% for the original vegetative cover. Forage for sheep and wildlife would be inadequate due to vegetative composition of the reclaimed areas. The grassland type of vegetation would furnish approximately 10% to 15% of wildlife dietary needs. With the passing of time (40 to 50 years) and proper management, further soil development

Table SI3-8

OVERBURDEN ANALYSIS FOR SUITABILITY AS SOIL MATERIAL

Test Hole #	Depth of Level (feet)	Limiting Factors*
OB-1	16.6-23.8	Low pH
OB-2	55.9-60.1	Low pH
	101-105	Low pH
OB-4	59.7-72	High pH, E.C., SAR
OB-5	19-252	High pH, E.C., SAR
OB-1813	82.8-98.3	High pH
OB-2408	9.8-19.3	Low pH
	117-180	High SAR
OB-3530	18.3-22	High E.C.
	102-128	High pH, SAR
	143-156	High SAR
	183-195	High pH
	223-271	High pH
OB-3860	109-122	High pH
	128-149	High pH, SAR
	156-181	High pH, SAR
	196-213	High SAR
OB-3894	0-4	High SAR
	141-246	High pH, SAR

*Limiting Factors
Low pH--acidic material; High pH--alkaline material; E.C.--salinity; SAR--alkalinity and/or salinity

Table SI3-9

NONCUMULATIVE AND CUMULATIVE ACREAGE OF VEGETATIVE TYPES
DISTURBED BY VARIOUS FACILITIES OR ACTIVITIES BY TIME PERIODS

FACILITY OR ACTIVITY	RANGE TYPE AND TIME PERIOD											
	Sagebrush			Birdfoot Sagewort			Greasewood			Total		
	1980	1983	Total	1980	1983	Total	1980	1983	Total	1980	1983	Total
Final Contour	356	761	1,117	146	142	288	--	--	---	502	903	1,405
	(356)	(1,117)		(146)	(288)					(502)	(1,405)	
Mine Facility	34	7	41	5	2	7	2	--	2	41	9	50
	(34)	(41)		(5)	(7)		(2)	(2)		(41)	(50)	
Ancillary Facility	3	--	3	2	--	2	--	--	--	5	--	5
	(3)	(3)		(2)	(2)	--	--	--	--	(5)	(5)	
TOTAL	393	768	1,161	153	144	297	2	--	2	548	912	1,460
	(393)	(1,161)		(153)	(297)		(2)	(2)		(548)	(1,460)	

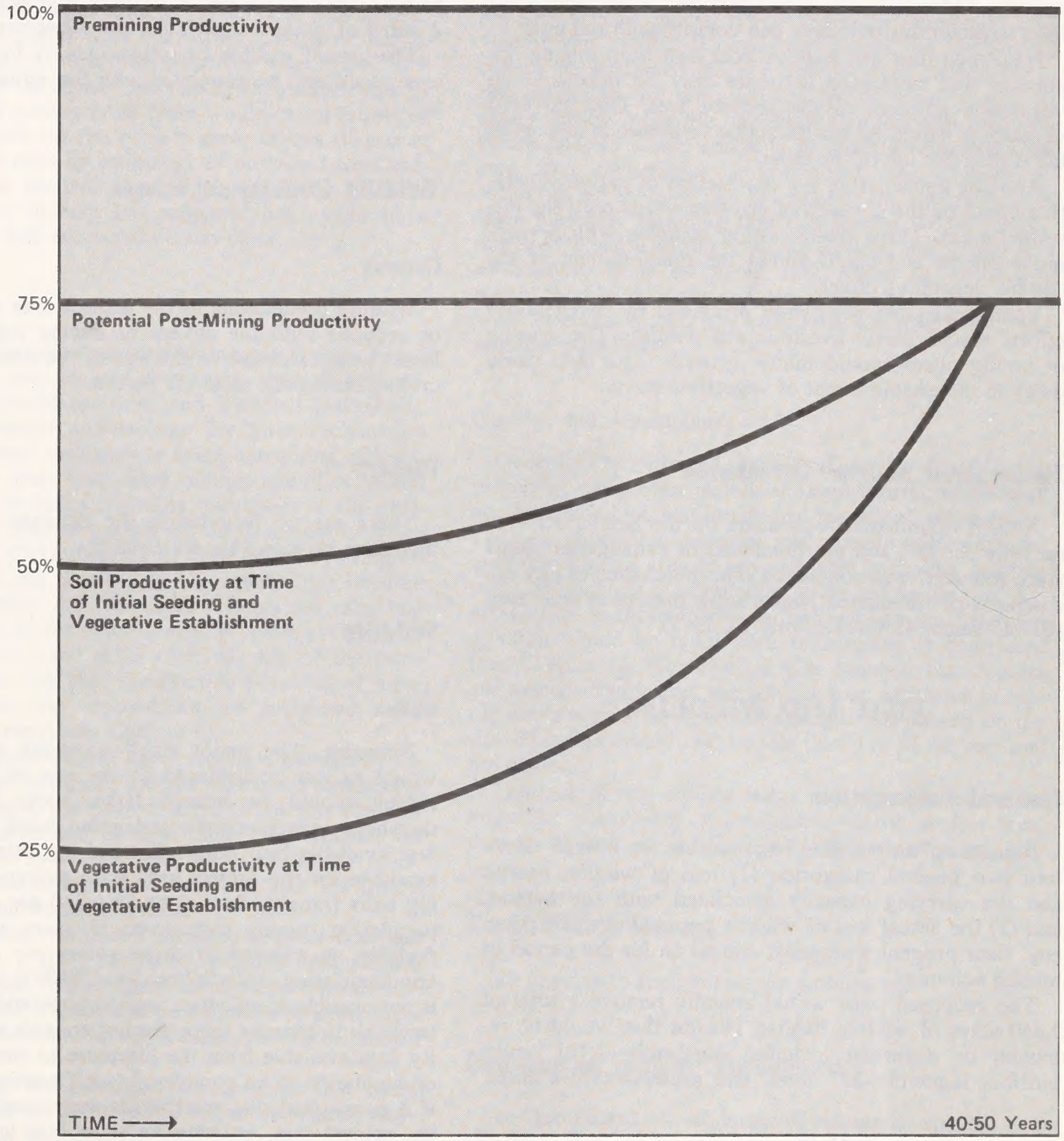


Figure SI 3-1

SOIL AND VEGETATIVE PRODUCTIVITY UNDER THE PROPOSED ACTION
Seminoe I

would occur and through natural plant succession, vegetative production would increase to the 565 pound per acre level. Composition would change with a significant increase in shrub populations and a slight reduction of the grass and forb production. A composition similiar to present day composition is expected to be attained on the area approximately 40 years after initial reclamation efforts. Since the management objective is to restore the lands as sheep range and wildlife habitat in a timely manner, additional mitigation measures would have to be used to attain this objective and comply with the law.

Haul road dust and fugitive coal dust from mining operations and associated activities may be deposited on vegetation adjacent to the activity area. Dust covered vegetation would be less palatable to livestock and wildlife during the life of the mine.

Another impact from the destruction of native vegetation could be the invasion of noxious weeds onto the disturbed areas. These weeds would compete with revegetative efforts and could inhibit the establishment of the desired vegetative cover.

Young palatable vegetation produced by revegetation efforts would attract livestock and wildlife. The grazing of young plants would inhibit growth vigor and cause delay in the establishment of vegetative cover.

Endangered and/or Threatened

A field examination was made on the Seminoe I area on May 5, 1977, and no threatened or endangered plants were found. It was concluded that the chance of any endangered or threatened plants being present is near zero (BLM Memo, 4510 (932), July 22, 1977).

FISH AND WILDLIFE

General Information

Impacts to the wildlife resource can be broken down into two general categories: (1) loss of wildlife habitat and the carrying capacity associated with the habitat; and (2) the actual loss of wildlife population, their progeny, their progenies progeny, and so on for the period of mining activities.

The proposed mine would actually remove a total of 1,460 acres of wildlife habitat. Habitat that would be removed or disturbed includes; sagebrush—1,161 acres, birdfoot sagewort--297 acres, and greasewood—2 acres.

Habitat Losses

The proposed mine would result in both direct and indirect losses of wildlife habitat. Direct losses would include habitat that is removed by the actual mining operations and the construction of ancillary facilities. Losses of habitat that could be classed as indirect would be those areas of habitat that are not physically destroyed, but become temporarily unusable by wildlife because of isolation, noise, dust, etc. This could also be called a "zone of influence"around the actual disturbed area. Direct losses of habitat on the project area would be 548 acres by 1980 composed of 393 acres of sagebrush (71%) 153 acres of birdfoot sagewort (28%) and 2 acres of greasewood (1%). Losses of wildlife habitat by 1983 would total 1,460 acres composed of 1,161 acres of sagebrush (79%); 297 acres of birdfoot sagewort (20%); and 2 acres of greasewood (1%) (see Chapters 4, 5 and 6).

The loss of wildlife carrying capacity for various species would also be associated with the actual loss of habitat.

Wildlife Population Losses

General

Wildlife populations in the project area would be lost or reduced with the advent of mining activities. These losses would increase as the size of the disturbed area increases during the mine life period.

Fishery

There are no fisheries in the Seminoe I Mine area; therefore, no losses are anticipated.

Wildlife

Birds

Nongame. The major small nongame songbirds that would be lost or displaced by the loss of 1,460 acres of habitat would be horned larks, snow bunting, sage thrashers, sage sparrows, and green-tailed towhees. The best available bird population density estimate presently available for the project area is an average of 21 breeding pairs (ranging from 8 to 55 pairs) per 100 acres, the population turning over every 3 years, and each pair fledging an average of three young per nest (personal communication, Max Schroeder, USFWS, April 1978). It is not possible to calculate a good population estimate for small birds because there are not enough natural mortality data available from the literature to enable a computer simulation to be completed (see Chapter 6). However, if it is assumed that small birds are spaced equally over the project area, estimates of small bird losses would be 38% of the population on the site. Additionally, this loss would be less than 1% of the regional population.

Current reclamation plans indicate that all disturbed areas would be seeded to a perennial grass stand. A change such as this in the vegetative complex could alter the species makeup of the small bird population in the area. Shrub habitat for native species would be eliminat-

ed and grassland bird species could filter in to inhabit the area.

There would be a loss of one raptor nest (buteo), and some disturbance to an active golden eagle nest since it is located within 1 mile of some of the proposed surface mining.

Game. Sage grouse are the only game bird that would be impacted by the proposed action. The proposed mining operation would disturb 384 acres of crucial nesting habitat associated with a strutting ground or lek located southeast of the project area (see Map SI2-4). If it is assumed that sagegrouse hens space themselves equally throughout the nesting area, there would be an estimated five nests located on the project area. Losses of grouse by 1980 would total an estimated 29 birds and total estimated losses by the end of mine life would be 57 birds. These estimates include the progeny that would have been produced had mining not taken place.

Mammals

Nongame. The principal small nongame species found on the project area include deer mice, least chipmunks, Richardson's ground squirrels, and whitetail jackrabbits. Removal of topsoil and storage for later reclamation would cause direct mortality to small burrowing rodents. Losses due to these and other mining activities would not only result in direct mortality, but losses to the project area would also be caused by displacement of more mobile animals. Quantification of these losses by computer simulation is not possible at the present time because published mortality data for small rodents are rare, and not available at all for southcentral Wyoming. Losses of small rodents on 1,460 acres over the life of the mine would be heavy, but the reproductive potential of these species indicates the repopulation of reclaimed mine areas would be rapid (see Chapter 6).

The significance of these losses can be estimated by assuming that small nongame rodents will space themselves equally throughout the project area. Using this assumption, it is estimated that 38% of these small rodents on the site would be lost due to mining. In addition, it is estimated that these losses would total less than 1% of the regional small mammal population.

The revegetation of mined areas to a grass complex could result in a different small mammal population, since small rodents that frequent shrub habitat would not infiltrate back into a reclaimed area planted to grass (personal communication, Max Schroeder, USFWS, March 1978).

Game. During the estimated 4-year mine life, there would be a loss of about 1,460 acres of winter/yearround habitat for pronghorns. Mine associated activities and loss of habitat would displace the estimated population of ten pronghorns that occur on the area. Since the numbers are so small no adverse impacts are anticipated to pronghorns since they can easily be absorbed into surrounding areas.

Mule deer range lost during the anticipated 4-year mine life would total about 1,460 acres. The Wyoming Game and Fish Department estimates that the total mule deer population on the project area is seven animals. Adverse impacts to this small number of deer are not anticipated, since nearby ranges can easily absorb these seven animals.

The complete removal of 1,460 acres of brushland habitat would result in a population loss to desert cottontails on the project area. The Wyoming Game and Fish Department estimates that there are about five rabbits per acre in these habitat types (Wyoming Game and Fish Department 1977). Cumulative losses of cottontails cannot be simulated since mortality data needed for a simulation run are not available. While losses would be heavy during mine life, the high reproductive potential of this species would enable it to quickly repopulate the area after reclamation is completed (see Chapter 6). However, an estimate can be made of the significance of these losses by assuming that this species would distribute itself equally throughout the project site. Using this assumption, it is estimated that losses to cottontails would total 38% of the population present on the project area. In addition, this loss would be less than 1% of the regional population.

Reptiles and Amphibians

General. The principal reptile species that could be impacted by the project include nothern shorthorned lizard, northern side-blotched lizard, and terrestrial garter snake. Data on population densities and mortality rates are not available for this area or any area that is similar, so computer simulations of population losses cannot be run. Reproduction in these species is high enough so that repopulation would be rapid once reclamation is completed (see Chapter 6). However, if it is assumed that reptiles are spaced evenly over the project area, estimates of reptile losses would be 38% of the population present on the site. This loss would also be less than 1% of the regional population.

The lack of free surface water and riparian vegetation limits the occurrence of amphibians in the project area, thus no impacts are anticipated to this class of animal.

Feral (Wild) Horses

No impacts to feral horses are anticipated.

Endangered and/or Threatened

No threatened or endangered mammal species are known to exist on the project area. However, in accordance with Section 7 of the Endangered Species Act of 1973, consultation has been requested from the U.S. Fish and Wildlife Service concerning black-footed ferrets on or near the project site because of several whitetail prairie dog colonies on and near the site. In accordance with this request, a ferret recovery team will be surveying possible ferret habitat during August and September 1978.

No species of birds in these categories are known to exist on the proposed site. There is a possibility that the project area may be used by migratory bald eagles and peregrine falcons. No impacts are anticipated on these species. However, in accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter dated August 11, 1978. Coordination with the U.S. Fish and Wildlife Service, under the Bald Eagle Act of 1940 as amended, concerning the active golden eagle nest on the project area was requested by letter dated April 21, 1978.

There are no known threatened or endangered fish, reptiles or amphibians occurring on the site, so no adverse impacts are anticipated.

CULTURAL RESOURCES

Ten sites in the Seminoe I project area need further testing to determine their eligibility for nomination to the National Register. If any sites, after testing, and after consultation with the SHPO and the Advisory Council on Historic Preservation, are determined to be of National Register Quality, 106 Compliance will be completed.

Subsurface sites which cannot be located prior to mining may be impacted by mining operations.

VISUAL RESOURCES

Visual resources contrast ratings were derived for the Seminoe I project area using a place along U.S. Highway 30 as a critical viewpoint (Map SI2-6). These contrast ratings, summarized in Table SI3-10, are available for review at the Rawlins District Office of the BLM. Further explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is available in the library of the Rawlins District Office of the BLM.

Contrast ratings are assessed in terms of how the proposed action would affect the basic elements (form, line, color, and texture) of the existing landscape features; landform, vegetative pattern, and structures (e.g., power lines and buildings). Resultant contrast ratings are then compared to the maximum acceptable impact limit for the visual resource management (VRM) class as seen from a viewpoint. Two time periods (during active mining and post reclamation) were used for the Seminoe I Mine contrast ratings.

Viewpoint A

From this viewpoint, the southern portions of the project area are visible. Mining activities and structures in the Class III area would create strong contrast to all basic elements. The visual resource management class would change to a Class V in the actual mining area.

RECREATION RESOURCES

Visitor Use Data

Table SI3-11 depicts estimated resident visitor use changes by activity due to coal mining in the years 1980 and 1985. The changes are those which would occur in the region and result from increased population in Carbon County. Data used to calculate use are available in the files at the BLM Rawlins District Office.

Hunting

Impacts to hunting would result when restricted access or displacement occurs to antelope, rabbit, rodent, and game bird populations. This would result as construction and mining destroy wildlife habitat (see Fish and Wildlife). With an increased number of people in the area, some ranches would restrict access across private lands. Increased human population would induce a greater demand for hunting and decrease the quality of the hunting experience in the area.

Sightseeing

The construction and mining would cause some impacts to existing recreational sightseeing values in the area. There would be impacts to wildlife sightseeing due to the displacement of animal species. There would be opportunities for geological and industrial interpretation as the mining operations draw people in to view the area.

Specialized Activities

Off-road vehicle use would be restricted from the mining area for safety reasons.

General

With an increased visitor use due to increased population in Carbon County, there would be a general lowering of the quality of the outdoor recreation experience in the area surrounding the Seminoe I project. There would also be increased use in urban recreation areas in the city of Rawlins and the towns of Hanna and Saratoga.

AGRICULTURE

Livestock Grazing

The destruction of vegetation through the development of this project would affect the grazing on the

Table SI3-10

SUMMARY OF VISUAL CONTRAST RATINGS

Views from Critical Viewpoing	A
Visual Management Class	III
During Active Mining (Land)	3/26
Post Reclamation (Land)	2/19
During Active Mining (Vegetation)	3/30
Post Reclamation (Vegetation)	3/23
During Active Mining (Structure)	2/20
Post Reclamation (Structure)	2/13

In a visual resource management Class III, the maximum acceptable impact should not exceed 2/16.

Table SI3-11

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO
POPULATION CHANGE FOR YEARS 1980, 1985, 1990

	Fishing	General**	Hunting	Off-road vehicles	Urban recreation***	Water Sports****	Winter Sports*****
1977	75,554	96,984	23,974	2,902	46,131	34,872	9,263
1980 (population 27)*							
without proposed action	91,808	117,946	28,299	3,453	58,973	43,420	12,097
increase due to proposed action	115	148	35	47	74	54	15
total projection	91,923	118,094	28,334	3,457	59,047	43,474	12,112
% of projection due to proposed action	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
1985 (population 91)*							
without proposed action	112,268	146,494	33,707	4,144	77,006	55,225	16,594
increase due to proposed action	394	514	118	15	270	195	58
total projection	112,662	147,008	33,825	4,149	77,276	55,420	16,652
% of projection due to proposed action	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%

Table SI3-11

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO
POPULATION CHANGE FOR YEARS 1980, 1985, 1990
(CONTINUED)

	Fishing	General**	Hunting	Off-road vehicles	Urban recreation***	Water Sports****	Winter Sports*****
1990 (population 0)*							
without proposed action	129,429	170,800	38,415	4,724	92,493	65,306	20,094
increase due to proposed action	0	0	0	0	0	0	0
total projection	129,429	170,800	38,415	4,724	92,493	65,306	20,094
% of projection	0%	0%	0%	0%	0%	0%	0%

* Population changes due to project (socioeconomic section)

** General includes camping, picnicing, sightseeing, etc.

*** Urban includes rodeos, golfing, and attending athletic events

**** Water includes boating, swimming, and water skiing

***** Winter sports includes only skiing

Dana Meadows North and Quealy Block allotments. As outlined in the assumption and guideline section, vegetative cover would be established 7½ years after reclamation is initiated. Under the reclamation procedures as outlined in the proposed action, the resulting vegetative cover would be principally grasses (Chapter 3, Vegetation) and would be most suited for grazing of cattle. However, since the objective of reclamation is to return the land to its premining uses of sheep grazing and wildlife habitat, the vegetation would not be suitable for these uses at this point of time. The time period needed to require vegetation similiar to premining vegetation would be greatly extended. It is estimated that it would take 40 to 50 years for the natural succession process to establish the desired vegetative species and composition suitable to meet the management objectives. Under the premise, grazing would not be fully restored on the Quealy Block allotment until 2019, and by 2023 on the Dana Meadows North allotment. The anticipated cumulative loss of Animal Unit Month (AUMs) of grazing on each of these allotments would be: Quealy Block—32 AUMs by 1980, 112 by 1985, 192 by 1990, 352 by 2000, 514 by 2010, and 640 by 2018; Dana Meadows North—43 AUMs by 1980; 619 by 1985; 1,268 by 1990; 2,568 by 2000; 3,868 by 2010; 5,111 by 2020; and 5,200 by 2023. Tables SI3-12 and SI3-13 depict mathmatical projections of this grazing loss on each allotment.

As shown in the above referenced tables, a total of 25 acres would be permanently removed from production as it is expected that the access road would be retained as part of the permanent road system for the area. This loss of 25 acres of production would result in a permanent loss of approximately 2 AUMs yearly on the Dana Meadows North allotment and less than 1 AUM on the Quealy Block allotment. These losses can readily be absorbed within the remainder of the allotment.

The removal of the division fence between the two allotments would not have any impact on the management of livestock on the allotments since mining and associated activities would preclude any grazing of the area. The fence would be replaced prior to returning the reclaimed areas to grazing use.

One stockwater pond would be destroyed or rendered useless. Since the reservoir is less than 1 mile from another reservoir, the loss of the reservoir would not have significant impact on livestock. The impact of the loss of the reservoir would be the inconvenience incurred until it was replaced. The loss of use would occur during mining and reclamation.

MINERAL RESOURCES

Coal

The two impacts associated with mining would be the removal of 5.2 million tons of coal and the loss of another 0.57 million tons that would be unrecoverable (left in the ground) due to present mining methods. Losses would be primarily caused by dilution with waste material at the top and bottom of the coal seam.

Scoria

The 4.1-mile access road construction would require 6,000 cubic yards per mile, or 24,600 cubic yards of scoria.

SOCIOECONOMICS

Demographics

Population

The Seminoe I project would increase population in the region by 91 people between 1979 and 1985 (Table SI3-14). After 1985, when the Seminoe I project is completed, this population would either leave or stay due to other employment in the region. The majority of the new population would live either in Rawlins (53%), which is located about 40 miles to the west, or in the Hanna/Elmo area (27%) which is immediately adjacent to the mine. With the project, the 1985 population of Rawlins would be only 0.3% greater than the expected population without it. The 1985 population of the Hanna/Elmo area would be only 1.1% greater than the population expected without it.

Employment

Construction on the Seminoe I project would take place during 1979. Mining in the project area would begin in 1980, adding 25 people to existing work force at the Seminoe I Mine. Miners and mine-related construction workers receive higher wages than employees in other sectors of the economy, so the Seminoe I project would be in a favorable situation to compete with other employers in the region for the available labor supply. This may actually lead to a slower growth in employment in other sectors of the economy for the years immediately following the mine employment increases. In 1980, there would be 25 new workers at the mine, but only 13 new workers in the region (Table SI3-15). Thus, there would be a net decline of 12 workers in other sectors of the economy. This impact would be felt most strongly in agriculture, retail trade, services, and some local government departments (e.g., police and fire) where wages are traditionally low. This would be a temporary situation which would disappear when migration increases the available labor supply sufficiently to supply all potential employers.

In a report by F. L. Leisteritz and T. A. Hertsgaard, it was shown that when industry (coal development) moves into a rural area, farm and ranch operators are faced with the necessity of offering higher wages or reorganizing their farm or both. Operators of small farms

Table SI3-12

MATHAMATICAL PROJECTION OF ANIMAL UNIT MONTHS OF GRAZING LOST ON THE DANA MEADOWS NORTH

Year or Period	Acres Removed From Grazing		Acres Returned to Grazing		Acres Out Of Production	AUMs Lost	
	Yearly	Cumulative	Yearly	Cumulative		Yearly	Cumulative
1979	50	50			50	5	5
1980	334	384			384	38	43
1981	365	749			749	74	117
1982	365	1,114			1,114	111	228
1983	182	1,296			1,296	130	358
1984		1,296			1,296	130	488
1985		1,296			1,296	130	618
1986-1990		1,296			1,296	650	1,268
1991-1995		1,296			1,296	650	1,918
1996-2000		1,296			1,296	650	2,568
2001-2005		1,296			1,296	650	3,218
2006-2010		1,296			1,296	650	3,868
2011-2015		1,296			1,296	650	4,518
2016		1,296			1,296	130	4,648
2017		1,296			1,296	130	4,778
2018		1,296			1,296	130	4,908
2019		1,296	134	134	1,162	116	5,024
2020		1,296	286	420	876	87	5,111
2021		1,296	286	706	590	59	5,170
2022		1,296	286	992	304	30	5,200
2023		1,296	285	1,277	19*	2*	

*Utilization of the access road as a permanent road would remove 19 acres from production and result in a permanent loss of approximately 2 AUMs yearly.

Table SI3-13

MATHAMATICAL PROJECTION OF ANIMAL UNIT MONTHS OF GRAZING LOST ON THE QUEALY BLOCK ALLOTMENT

Year or Period	Acres Removed From Grazing		Acres Returned to Grazing		Acres Out Of Production	AUMs Lost	
	Yearly	Cumulative	Yearly	Cumulative		Yearly	Cumulative
1979	164	164			164	16	16
1980		164			164	16	32
1981-1985		164			164	80	112
1986-1990		164			164	80	192
1991-1995		164			164	80	272
1996-2000		164			164	80	352
2001-2005		164			164	80	432
2006-2010		164			164	80	514
2011-2015		164			164	80	592
2016		164			164	16	608
2017		164			164	16	624
2018		164			164	16	640
2019		164	158	158	6*	Less Than 1*	

*Utilization of the access road as a permanent road would remove 6 acres from production and result in a permanent loss of less than 1 AUM yearly.

Table SI3-14

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

County City	1977 Population	1980 Total with the Proposed Action	1980 Impact of the Proposed Action	1985 Total with the Proposed Action	1985 Impact of the Proposed Action	1990 Total with the Proposed Action	1990 Impact of the Proposed Action
Carbon County	18,137	21,604	27	25,994	91	29,530	0
Rawlins	10,500	13,277	14	16,920	48	19,959	0
Hanna/Elmo*	1,500	1,822	9	2,153	25	2,347	0
Elk Mountain	220	242	0	265	2	275	0
Medicine Bow	750	852	2	925	7	996	0
Saratoga	2,050	2,151	2	2,256	7	2,316	0
Encampment	500	529	0	558	2	577	0

* These towns are located several mines apart and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, Laramie, 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

Table SI3-15

SOUTHCENTRAL WYOMING EMPLOYMENT

Sector	1977 Total Employment	1980 Total with the Proposed Action	1980 Impact of the Proposed Action	1985 Total with the Proposed Action	1985 Impact of the Proposed Action	1990 Total with the Proposed Action	1990 Impact of the Proposed Action
Farm	526	525	0	525	0	525	0
Manufacturing	360	386	0	427	0	468	0
Mining	1,658	2,387	+25	2,872	+25	2,728	0
Construction	715	1,051	- 3	1,134	+ 2	1,488	0
Government	919	1,016	- 2	1,422	+ 3	1,754	0
Farm and Forest Processing	46	47	0	48	0	49	0
Railroads	480	540	0	680	0	780	0
Business Services	1,415	1,585	- 4	2,009	+ 4	2,433	0
Consumer Services	1,948	2,099	- 3	2,481	+ 5	2,877	0
Total Employment	8,067	9,635	+13	11,553	+39	13,102	0

Note: The impact of the proposed action is the difference between total employment with the proposed action and total employment without the proposed action.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming Water Resources Research Institute, Laramie, 1978.

and ranches who have been underemployed in their farm or ranch business may take advantage of the new off-farm job opportunities that coal development provides.

Operators who are fully employed with adequate incomes from agriculture and who do not hire much extra labor would be least affected by increased competition for labor. Those operating large farms and ranches requiring large amount of labor would be likely to make significant adjustments in their operations. These adjustments would likely include dropping certain labor-intensive enterprises, adopting labor-saving technologies, and perhaps even reducing the size of their operation.

New mining activity creates a need for additional employment in industries which serve the mine (e.g., mine supply firms) and in businesses and organizations which serve the new mine and mine-related employment (e.g., merchants, storekeepers, and school teachers). In 1985, there would be a total of 39 new workers in the region as a result of the proposed Seminoe I project which represents a total employment to direct mine employment ratio of about 1.6. This total employment increase would disappear by 1990 because of the mine's closing.

Income

The Seminoe I project would increase annual personal income in the region \$1.2 million (in constant 1977 dollars) by 1985 due to increased wage earnings (\$0.7 million) and proprietor's income (\$0.5 million). This would be an increase of only 0.4% over the personal income expected without the project. With 39 additional workers employed in 1985 as a result of the proposed action, the \$0.7 million rise in personal income would represent an increase of \$18,600 (in constant 1977 dollars) per additional worker.

This increase in income would create local inflationary pressures. This would occur because the miners and mine-related employees would have more money to spend on goods and services than would others. This would effect those on fixed incomes (retirees, welfare recipients, etc.) more than anyone else. As incomes and prices rise rapidly, their incomes do not. This effectively reduces their buying power.

Infrastructure

Private Sector

The increase in personal income in the region that would result from the Seminoe I project would generate additional wholesale and retail sales. These additional sales would be \$0.2 million in 1980 and \$0.5 million in 1985 (in constant 1977 dollars) (Centaur 1978).

Along with these increased sales there would be diversification of business types to take advantage of the new sales opportunities. New business would locate in the region that have not been represented in the local economy previously.

Although only 57% of the population increase resulting from the project would live in Rawlins, a much higher percentage of sales would occur there because of Rawlins' position as the major trade center in the region.

Housing

The Seminoe I project would create an additional housing demand of 77 units (19 single family units) by 1985 (Centaur 1978).

Housing demand is based on the historical relationship of 2.7 persons per housing unit in Carbon County. Housing shortages, which would be reflected by occupancy rates greater than 2.7 persons per housing unit, are difficult to anticipate. No major constraints to rapid expansion of mobile homes are known—trailer parks can be built quickly and financing has not been unduly difficult to obtain. Water and sewer moratoriums in several communities have been lifted due to new construction which has increased capacities.

Some new residents would be likely to rent rooms in existing homes, live temporarily in motels, or share rental units with others because they prefer those alternatives to mobile homes or because they are waiting for other housing to become available.

Demand for single family homes is estimated based on the expected preferences of new residents and long-time residents. New residents are often reluctant to purchase or build homes, so they would exhibit fewer demands for single family homes than those who have lived in the community for a number of years. The supply of single homes is not expected to rise sufficiently to meet this increased demand. Single family shortages now exist (partially the result of past construction moratoriums) and would likely become larger as a result of the proposed action.

Education

School-age population in District 01 would increase by seventeen by 1985. School-age population in district 02 would increase by eleven (Centaur 1978). The schools in Rawlins and Hanna would receive most of the additional enrollment. Those schools have sufficient capacity to absorb the increases.

Assessed value of School District 02 would be increased by the value of the mine property.

Health Care and Safety

The level of health care in Carbon County is currently inadequate with fewer physicians and dentists available than are needed by the existing (1977) population. With the proposed action, the present inadequate availability of health care specialists would worsen slightly. The Seminoe I project would not, by itself, create a demand for additional health care specialists.

The Memorial Hospital in Rawlins presently has a capacity for a population of about 29,000 to 33,000, compared to Carbon County's 1977 population of 18,137. The

additional 91 people that would come into the region as a result of the Seminoe I project would have little effect on the hospital capacity.

In 1974, the incidence of work-related injury or illness in Wyoming for all industries was 10.4 cases per 100 full-time workers (U.S. Department of Labor 1976). (This is the same incidence rate as for the United States as a whole.) Bituminous coal mining in Wyoming appears much safer than the average industry, with 5.2 cases of injury or illness per 100 full-time workers. (For the United States, the incidence rate for bituminous coal mining is 10.6 cases per 100 full-time workers). If the incidence rate for injury and illness in bituminous coal mining holds in the future, the additional coal mining at the Seminoe I Mine would increase injury and illness by an average of 1.3 cases per year in Wyoming. Those injuries that are fatal or debilitating would reduce long-term human productivity. Because bituminous coal mining appears safer than the "typical"private sector job, this increase in injury and illness is likely less than would be expected from employment increases in other sectors of the economy.

Local Services

The Seminoe I project would lead to increased population in Rawlins, the Hanna/Elmo area, and other Hanna Basin communities, placing additional demands on the local services (water, sewer, police, fire protection, solid waste) these communities provide to their residents. Because the expected regional population increase of 91 due to the proposed action would be small in comparison to the anticipated total regional population growth between 1977 and 1990 of 11,827, the impacts on the local community services attributable solely to the proposed action would be insignificant.

Transportation and Utilities

Highway access to the Seminoe I area is via U.S. 30, a paved, two-lane road. A 7-mile access road connects the mine area to the highway. About 3.5 miles of the access road is now located within the project area and would be moved to the southwest to allow mining activity to take place. An additional 0.6 miles of off-site access road would also need to be constructed. The relocation of the access road would generally be within the project boundaries and would not interfere with or disrupt vehicular traffic on public highways. Map SI3-1 shows the proposed site layout at the Seminoe I area.

Local access roads would receive the largest increase in travel due to the proposed mining activity, but it would not be significant enough to cause more than temporary congestion at the time the shifts change.

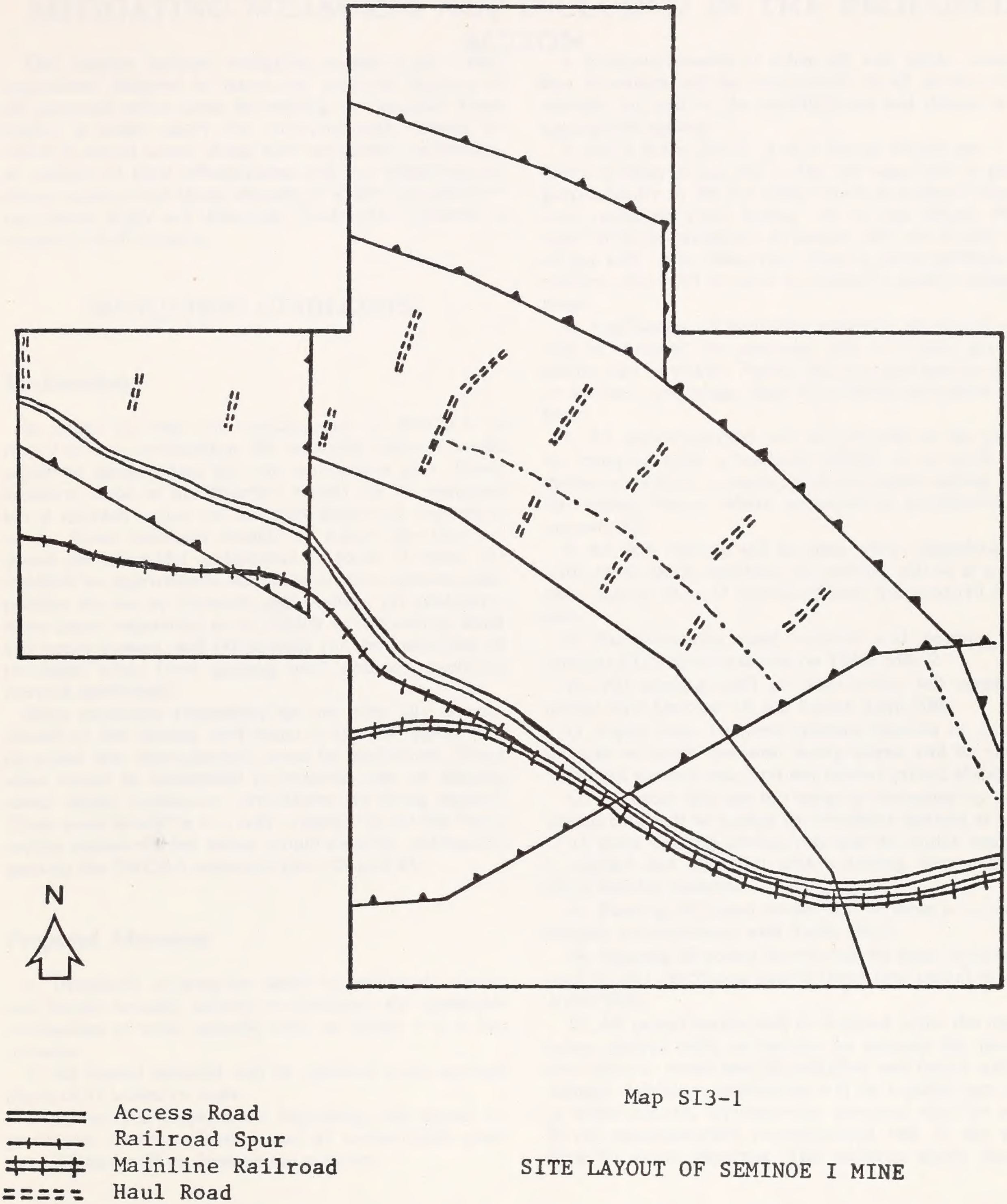
There would be no increase in coal train traffic as a result of the proposed action.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income), they would resent the increased population and urbanization that would occur, even though increases would be slight due to this one mine. Those persons who would benefit from the mine directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining section (Abt Associates 1977; Gilmore 1974).

Lifestyles

The changes currently occurring in the lifestyles of Carbon County residents (see Chapter 2, Lifestyles) would continue with or without this project. The Seminoe I project would reinforce and possibly speed up those changes in the impacted portions of the region (Rawlins, Hanna/Elmo). The magnitude of the impact that would be due to the Seminoe I project is not quantifiable.



Map SI3-1

SITE LAYOUT OF SEMINOE I MINE

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

This chapter includes mitigating measures and other regulations designed to lessen the potential impacts of the proposed action upon the existing environment. Each impact is listed under the environmental element to which it would occur, along with applicable regulations, an analysis of their effectiveness, and any remaining residual impact. Only those impacts to which mitigation or regulations apply are discussed; Table SI4-1 presents a summary of all impacts.

MITIGATION GUIDELINES

Reclamation

In order to meet the requirements of SMCRA in regard to land reclamation, the measures outlined herein would be incorporated into the reclamation plan. Those measures listed as discretionary would not be required, but if adopted would aid in establishment of vegetative cover. These measures would: (1) reduce the time required for successful reclamation to about 15 years, (2) establish an approximate natural vegetative species composition for use by livestock and wildlife, (3) establish a more dense vegetative cover which would reduce wind and water erosion, and (4) provide for the protection of reclaimed areas from grazing until desired vegetative cover is established.

Since successful relamation has not been fuly demonstrated on the existing coal mines in the ES region, it is proposed that demonstration areas be established. These areas would be established on selected sites on existing mines where reclamation procedures are being applied. These areas would be to verify whether or not the reclamation measures listed below would result in reclamation meeting the SMCRA standards (see Chapter 8).

Proposed Measures

1. Unsuitable overburden shall be separated, stored, and buried beneath suitable overburden. All unsuitable overburden or toxic material shall be buried 6 to 8 feet or more.
2. All topsoil material will be replaced to an average depth of 12 inches or more.
3. All seedbed preparations, beginning with topsoil replacement, seeding, planting, and all conservation practices initiated will be done on the contour.
4. Contour terraces or other soil and water conservation structures will be constructed on all slopes recommended by, and to the specifications and design of the appropriate agency.
5. Snow fence panels (5 to 6 feet in length and 3 feet high) or bales of hay set on the cut edge will be placed perpendicular to the prevailing wind at random intervals over reclaimed areas having 3% or less slopes. Placement of snow catchment structures will not be less than 60 per acre. After bales have been in place through two winters, they will be used as mulch in newly reclaimed areas.
6. Application of mulching materials to seeded areas will be done at the minimum rate of 2 tons per acre (native hay or straw). Native hay or straw used as mulch or for snow catchment must be certified as noxious weed free.
7. All mulch material will be anchored to the ground by crimping with a notched coulter to a depth of 5 inches or more or covering with a suitable netting material except slopes where steepness is prohibitive (see measure 12).
8. All drill seeding will be done with a rangeland drill with depth bands attached. All seeding will be at a minimum rate of 13 to 15 pounds of pure live seed (PLS) per acre.
9. Recommended seed mixture and seeding ratio (pounds PLS/acre) is shown on Table SI4- 2.
10. All seeding shall be done when soil conditions permit after October 1st and before April 30th.
11. Open areas between contour furrows or contour terraces on south and west facing slopes will be planted with seed mixture only and not receive potted shrubs.
12. All areas that are too steep to be seeded by a rangeland drill will be seeded by broadcast method at a rate of 1½ times the drill seeding rate and the mulch manually applied and anchored with a netting, wire mesh, or other suitable material.
13. Planting of potted shrubs will be done in a random manner in accordance with Table SI4-3.
14. Planting of potted shrubs will be done in spring as soon as soil conditions permit (frost free period prior to April 30th).
15. All potted shrubs will be watered while the plant is being planted with an amount to saturate the planting root zone to avoid root dehydration and insure soil-root contact. Minimum application will be 1 gallon per plant. A water soluable fertilizer-root stimulant shall be added at the manufacturer's recommended rate to the water used for shrub plantings. This additive would increase

Table SI4-1

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Climate	N/A*	N/A	N/A	N/A	N/A
Air Quality					
AQ-1	N/A	N/A	N/A	N/A	All
AQ-2	N/A	N/A	N/A	N/A	All
AQ-3	N/A	N/A	N/A	N/A	All
Geology					
Paleontology					
GE-1	N/A	N/A	N/A	N/A	All

* Not applicable; that is, no portions of SMCRA apply directly to the specific impact, therefore, other columns on the table may not apply.

Table SI 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Topography					
TO-1	30 CFR 715.14	N/A	Grading and contouring in reclamation plan	Area would be returned to original topography	None
TO-2	30 CFR 715.14(d)	N/A	N/A	N/A	Small depressions would be left
Soils					
SO-1	N/A	N/A	N/A	N/A	All
SO-2	30 CFR 715.16	3041 and 211	Revise reclamation plan to to provide for retention of premining levels of soil productivity	Post-mining potential soil productivity levels equal to premining levels	Soil productivity would be lost on disturbed lands until reclaimed
SO-3	30 CFR 715.13 30 CFR 715.14 30 CFR 715.16 30 CFR 715.20	3041 and 211	Revise reclamation plan to provide for reductions in erosional rates	An estimated 75% reduction in erosional rates	An estimated 25% of erosional losses would continue
SO-4	N/A	Mining and reclamation plan and EPA	None	An estimated 50% reduction in fugitive dust (soil loss) from haul road	An estimated 50% of haul road dust would remain as residual

Table SI 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Soils (continued)					
SO-5	30 CFR 715.14 30 CFR 715.16(a) 30 CFR 715.16(c)	3041 and 211	Revise mining and reclamation plan to reduce erosion on stockpiled material	An estimated 75% reduction of erosion on topsoil storage areas	An estimated 25% residual erosion on topsoil storage areas would remain.
SO-6	30 CFR 715.14(j)	3041 and 211	Revise reclamation plan to bury all contaminated soils	Burial of contaminated soil would be 100% effective	None
SO-7	30 CFR 715.14 30 CFR 715.14(i)	3041 and 211	Revise reclamation plan to miminize erosion rates	An estimated 75% reduction in in erosional rates	An estimated 25% residual erosion soil losses would continue
SO-8	30 CFR 715.14(j)	3041 and 211	Revise mining and reclamation plan for separation and burial of unsuitable overburden material and parting beneath suitable overburden material	Separation and burial of unsuitable overburden and parting material as well as mixing of possible toxic material would be 100% effective	None

Table SI 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Water Resources					
WR-1	30 CFR 715.17(i)	State of Wyoming	Replacement of facility	Would alleviate impact	None
WR-2	30 CFR 715.17(i)	State of Wyoming	Replacement of facility	Would alleviate impact	None
WR-3	N/A	N/A	N/A	N/A	All
Vegetation					
VG-1	N/A	N/A	N/A	N/A	Loss of native vegetation on 1,460 acres
VG-2	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 and 211	Revise reclamation plan to provide for establishment of vegetative cover of native species in a timely manner	Reduce time of establishment of vegetative cover of native species by 25 to 30 years	Loss of native vegetative cover for 10 to 15 year period
VG-3	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 and 211	Revise reclamation plan to provide for revegetation in a manner that is timely and and encourages a prompt vegetative cover and recovery of productivity levels	Reduce time of establishment of vegetative cover and recovery of productivity levels by 25 to 30 years.	Loss of native vegetation and productivity for 10 to 15 year period

Table SI 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Vegetation (continued)					
VG-4	N/A	EPA	N/A	Control of haul road dust and fugitive coal dust would be 50% effective	Palatability of vegetation would be affected for life of the mine
VG-5	None	State of Wyoming	Revision of reclamation plan to provide for control of noxious weeds.	Noxious weeds would be controlled	None
VG-6	N/A	N/A	N/A	N/A	Loss of native vegetation on 20 acres
VG-7	30 CFR 715.13(a)	3041 and 211	Revise reclamation plan to provide for revegetation in a manner that would encourage recovery of productivity levels in a timely manner	Vegetative productivity level could be recovered to premined level	None

Table SI 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Fish and Wildlife					
WL-1	30 CFR 715.13(a) 30 CFR 715.20(e)	N/A	All disturbed areas shall be restored in a timely manner. Vegetative cover of species native to the area shall be established fullfill the needs of native wildlife	Will shorten the reclamation period from 40 to 50 years down to 10 to 15 years	10 to 15 years of wildlife habitat loss
1a				Reduce the loss of small nongame birds	unquantifiable
1b				Reduce the loss of 574 sagegrouse	359 grouse lost
1c				Reduce the loss of small nongame rodents	unquantifiable
1d				Reduce the loss of cottontail rabbits	unquantifiable
1e				Reduce the loss of reptiles	unquantifiable

Table SI 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Cultural Resources					
CR-1	N/A	106 Compliance	N/A	Subsurface cultural material could be lost since it would not be identified prior to surface disturbing activities	Loss of some cultural material
Visual Resources					
VR-1	30 CFR 715.13 30 CFR 715.20 30 CFR 715.14	N/A	Recontouring, revegetation	Could be returned to existing visual class	None

Table 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Recreation Resources					
RE-1	N/A	N/A	N/A	There are no regulations or mitigation concerned primarily with recreation. However, if reclamation for wildlife species was successful, the hunting aspects of recreation should be improved.	All
Agriculture					
AG-1	30 CFR 715.13(a) 30 CFR 715.20(a)	3041 and 211	Revise reclamation plan to provide for establishment of vegetative cover of native species in a timely manner	Reduce time of establishing suitable sheep range by 25 to 30 years	Loss of sheep range for a 10 to 15 year period
1a				Reduce grazing loss from 5,480 AUMs to 2,190 AUMs	Loss of 2,190 AUMs of grazing
AG-2	30 CFR 715.13(a)	N/A	N/A	One stockwater pond would be replaced	Loss of use of stock-water reservoir during mining and reclamation

Table SI 4-1 (continued)

SUMMARY OF IMPACTS AND APPLICABLE REGULATIONS

Resource and Impact Number	SMCRA Requirements	Other Requirements	Portion of Mining and reclamation plan requiring change	Effectiveness and Feasibilty	Residual Impact
Mineral Resources					
MR-1	N/A	N/A	N/A	N/A	All
Socioeconomics					
SE-1	N/A	N/A	N/A	N/A	All
SE-2	N/A	N/A	N/A	N/A	All
SE-3	N/A	N/A	N/A	N/A	All
SE-4	N/A	N/A	N/A	N/A	All
SE-5	N/A	N/A	N/A	N/A	All
SE-6	N/A	N/A	N/A	N/A	All
SE-7	N/A	N/A	N/A	N/A	All
SE-8	N/A	N/A	N/A	N/A	All
SE-9	N/A	N/A	N/A	N/A	All
SE-10	N/A	Mine Health and Safety Act of 1969, as amended	N/A	N/A	Unknown
SE-11	N/A	Mine Health and Safety Act of 1969, as amended	N/A	N/A	Unknown

Table SI4-2

RECOMMENDED SEED MIXTURE

Species Name	Ratio of seeding
Rosana western wheatgrass	3 to 4 pounds PLS/acre
Sodar streambank wheatgrass	1 to 2 pounds PLS/acre
Indian ricegrass	1 to 2 pounds PLS/acre
Bluebunch wheatgrass	1 to 2 pounds PLS/acre
Critana thickspike wheatgrass	1 to 2 pounds PLS/acre
Sweetclover	0.5 to 1 pounds PLS/acre
Four-wing saltbush	2 to 3 pounds PLS/acre
Winterfat	1 to 2 pounds PLS/acre

Table SI4-3

SHRUB PLANTING DENSITIES

Plant Species	Level Areas	Aspect along terraces, contours, catchment basins special areas *	North and East Slopes Upper Third	North and East Slopes Mid Third	North and East Slopes Lower Third
Big Sagebrush	250**	350	250	300	400
Bitterbrush	200	150	200	150	---
Little Rabbitbrush	100	100	100	75	---

* Special areas may include constructed draws, swales, leeward side of snow catching structures

** Planting rate is number of potted shrubs per acre.

survival rate and increase growth vigor of the planted shrubs.

16. Shrub planting along contour furrows or contour terraces shall be of a width extending 1 foot above and 2 feet below the furrow or terrace.

17. All topsoil storage piles will be seeded with sodar streambank wheatgrass at the rate of 12 pounds pure live seed (PLS) per acre and a cover crop of fall rye (biennial plant) at a rate of 10 pounds PLS per acre.

18. All reclaimed areas will be fenced in a manner that would exclude livestock and pronghorn and not be a hazard to wildlife.

19. Where possible, all utility lines should be buried underground. This would significantly reduce vertical intrusions on the landscape.

20. All buildings, power line poles, conveyors, and any other type structures should be painted earth tone colors so they would blend into the landscape.

Discretionary Measures

1. On selected areas, in lieu of potted shrubs, plugs with native vegetation could be placed with a minimum spacing of three to seven per acre. Plugs would be 5 feet by 5 feet in size with a minimum depth of 3 feet. Plugs will be removed from areas planned to be stripped of topsoil. All plugging will be done during the months of February through May. Other times and methods of planting may be done with prior approval of the managing agency.

2. All seed would be prilled to aid in seed distribution and germination.

3. All seed would be treated with a repellant to prevent seed damage by rodents or birds.

4. In areas where rodent populations inhibit reclamation efforts, control measures would be initated to control the rodent population.

IMPACTS

Air Quality

No specific mitigating measures that would reduce air quality impact from the Seminoe I Mine site have been specified at this time.

Topography

Impact TO-1; mining operations would change the existing topographic features and drainage patterns. SMCRA regulations 30 CFR 715.14 require that the area be returned to the approximate original contour. With a properly designed grading and backfilling plan this could be accomplished on the Seminoe I site. If this was accomplished, there would be no residual impact.

Soils

Impact SO-2; loss of soil productivity on 1,460 acres would occur. SMCRA 30 CFR 715.16 requires that topsoil material be removed, stored, and redistributed on disturbed areas to retain soil productivity and enhance reclamation. With the application of SMCRA 30 CFR regulations, it is estimated that the potential soil productivity levels (post mining) would be equal to the premining levels. Soil productivity would be lost on the 1,460 acres during the time from disturbance until reclamation is successful. See Figure SI4-1.

Impact SO-3; increased soil loss would occur due to wind and water erosion on disturbed areas (1,435 acres). SMCRA 30 CFR 715.13, 715.14, 715.16, and 715.20 require that all disturbed areas be restored in a timely manner, conforming closely to original contour, with salvage of topsoil and establishment of a diverse and permanent vegetative cover of species native to the area. The application of SMCRA 30 CFR regulations would reduce the erosional rates on reclaimed areas by an estimated 75%. An estimated 25% of erosional losses would still occur.

Impact SO-5; increased wind and water erosion would occur on topsoil stockpiles and overburden spoil piles. SMCRA 30 CFR 715.14, 715.16(c), 715.16 (a1) require the topsoil piles be located as to minimize erosion. Measures to control erosion from overburden piles shall be specified by the regulatory authority. The application of SMCRA 30 CFR regulations would reduce erosion from topsoil storage areas by an estimated 75%. An estimated 25% of erosion would still occur. An indeterminate amount of erosion would occur off of overburden spoil piles.

Impact SO-6; toxic substances would contaminate soil profiles around mine facilities. SMCRA 30 CFR 715.14(j) requires all toxic or waste material be buried a minimum of 4 feet and/or treated to neutralize toxicity. The application of SMCRA 30 CFR regulations would control the impact 100%.

Impact SO-7; alteration of topography, slopes, and drainage patterns would result in increased water erosion. SMCRA 30 CFR 715.14 requires backfilling and grading conform as closely as possible to original contour and grading be done on the contour. Rills and gullies 9 inches or less on reclaimed areas shall be regraded and stabilized. The application of SMCRA 30 CFR regulations would reduce erosion on reclaimed areas by an estimated 75%. An estimated 25% of erosional losses would still occur.

Impact SO-8; exposure of toxic material (overburden and/or soil) would hamper revegetation efforts. SMCRA 30 CFR 715.14(j) requires all toxic or waste material be buried a minimum of 4 feet and/or treated to neutralize toxicity. The application of SMCRA 30 CFR regulations as well as the separation and burial of unsuitable overburden and parting material beneath suitable overburden material in the mining and reclamation process would control the impact an estimated 100%.

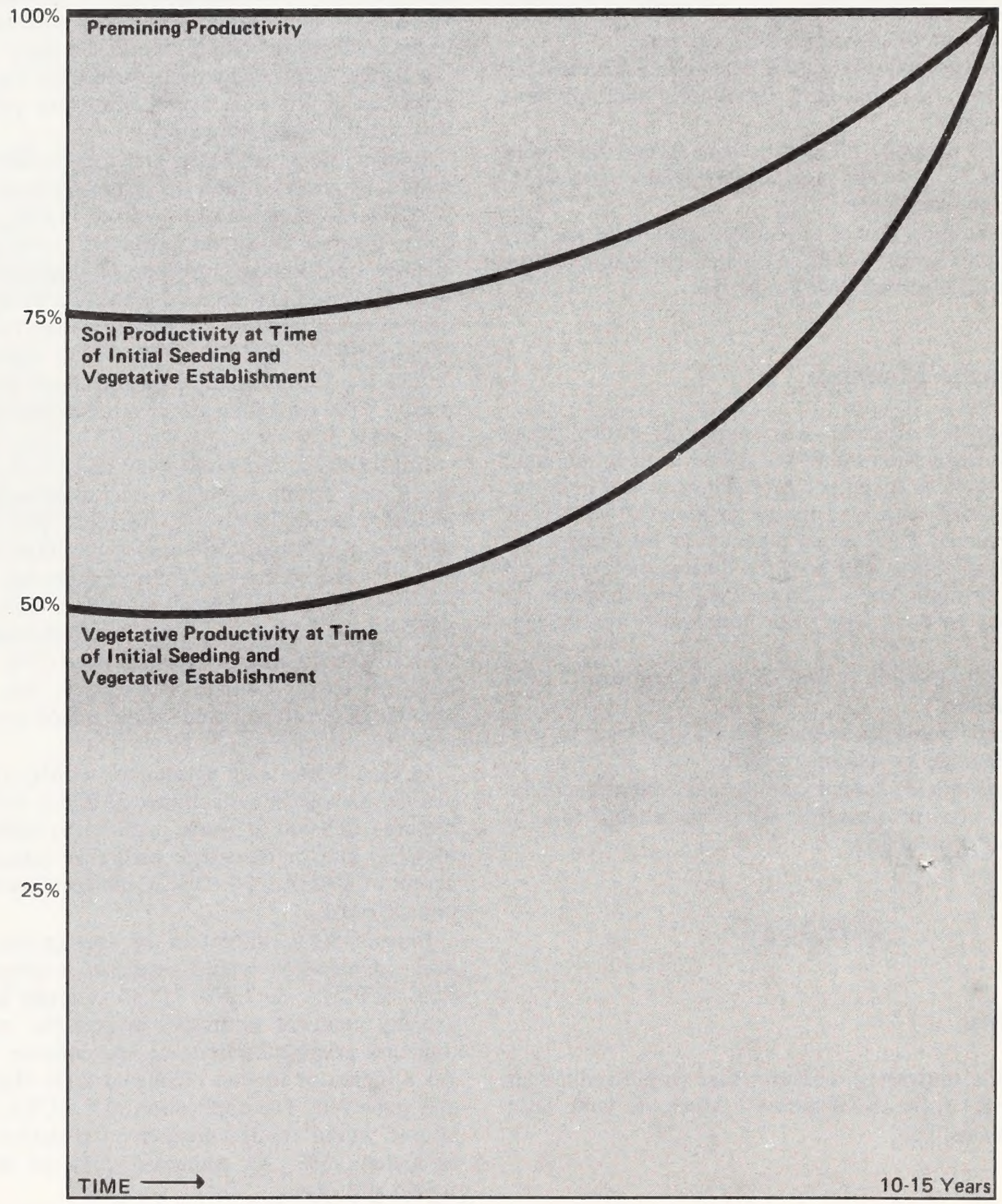


Figure SI 4-1

SOIL AND VEGETATIVE PRODUCTIVITY UNDER MEASURES REQUIRED TO MEET STANDARDS ESTABLISHED IN THE SURFACE MINING CONTROL AND RELAMATION ACT OF 1977

Seminoe I

Water Resources

Impact WR-1; mining operations could lower the water level in a well adjacent to the project area. SMCRA regulations 30 CFR 715.17(i) require the hydrologic system be protected. Under this regulation if the well water supply were affected, it would have to be replaced, and there would be no residual impact.

Vegetation

Impact VG-2; reclamation would result in conversion of vegetative type for a long-term (40 to 50 years) time period. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a) require the establishment on all lands that have been disturbed, a diverse, effective, and permanent vegetation of species native to the area and that restoration be in a timely manner. Under the proposed action, it is estimated that 40 to 50 years would be required to acquire a cover of native species since the proposed reclamation measures do not contain a species composition that would result in a vegetative cover similiar to premining vegetation. Proposed measures would not result in timely reclamation since natural succession would be relied upon to reestablish native vegetation. Through the application of the SMCRA regulations, the time periods for reclamation to vegetative cover of native species and composition could be reduced by 25 to 30 years with a residual loss of a 10 to 15 year period.

Impact VG-3; grazing of young plants on reclaimed areas would delay establishment of vegetative cover during a 40 to 50 year period. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a) require that restoration be carried out in a manner that encourages a prompt vegetative cover and recovery of productivity levels in a timely manner. Under the proposed action, no provisions are made for control of the use of the reclaimed areas by either domestic stock or wildlife. Grazing use of the reclaimed areas would affect vigor of young plants and cause delay in establishment of adequate vegetative cover. With the application SMCRA regulations, measures would have to be initiated to assure that vegetation could be established promptly without undue hinderances, which in turn would result in the recovery of productivity levels. The measures applied would apply solely to the control of grazing by livestock and pronghorn.

Impact VG-5; noxious weeds could invade onto disturbed and reclaimed areas. The State of Wyoming Noxious Weed Law requires that weeds identified by the state as being classified as noxious will be controlled. Under the proposed action, no provisions are made for compliance with this law. Revisions of the mining and reclamation plan are needed to include measures that would result in the control of noxious weeds. When the mitigation measures are applied as required by law full control of noxious weeds should be accomplished.

Impact VG-7; the vegetative productivity level on reclaimed lands is expected to be 565 pounds air dry vegetation per acre as compared to 752 pounds on premined acreage. SMCRA regulations require that revegetation shall be carried out in a manner that encourages the recovery of productivity levels in a timely manner. It is estimated that the soil and vegetative measures included in the proposed action are not stringent enough to establish the premining productivity level. Modification of the proposed measures to meet SMCRA standards would result in full recovery of premining productivity.

Cultural Resources

Impact CR-1; subsurface cultural material could be lost during mining since it might not be identified prior to surface disturbing activities.
The cooperative procedures between BLM and GS ("Cooperative procedures pertaining to the protection of cultural resources related to onshore mineral leasing operations exclusive of oil, gas, geothermal and oil shale") require that the Area Mining Supervisor, GS, be contacted by the operator if any subsurface cultural resources are located during mining operations. The site will be evaluated and if determined to be of National Register quality compliance with Section 106/2b of the Historic Preservation Act of 1966 would be completed.

Visual Resources

Impact VR-1; although no portions of SMCRA apply directly to visual resources, if reclamation measures required for other resources are carried out, the visual quality will be improved to present premining levels.

Agriculture

Impact AG-1; suitability of range for sheep grazing on 1,460 acres would be lost for 40 to 50 years. SMCRA regulations 30 CFR 715.13(a) and 30 CFR 715.20(a) (1) provide for establishment of vegetative cover of native species in a timely manner. Under the proposed action, the reclamation measures that would be applied would result in a vegetative cover that would be marginally suitable for sheep grazing. After primary reclamation efforts, natural succession would be the principal means for the establishment of additional native species that would return the area to a vegetative composition highly suitable to sheep grazing. The natural succession process is expected to take 40 to 50 years. With the application of SMCRA regulations, measures would have to be initiated that would enhance the establishment of shrub cover and to reduce the length of time required to establish a vegetative cover of desired species composition for sheep grazing by 25 to 30 years. The residual impact would be loss of sheep range for 10 to 15 years.

Impact AG-1a; loss of 5,480 animal unit months (AUMs) of grazing would occur during mining and reclamation. Under the proposed action, the destruction of 1,460 acres of sheep range for the duration of the reclamation period required to restore suitable sheep range by

natural succession (40 to 50 years) would result in a grazing loss of 5,480 AUMs. With the application of measures to meet SMCRA standards, suitable sheep range would be established 25 to 30 years sooner. The resulting loss of grazing would be confined to a 10 to 15 year period and would be approximately 2,190 AUMs.

Socioeconomics

Impacts SE-10 and SE-11; work-related injuries and fatalities would occur. The Mine Health and Safety Act of 1969, as amended, regulates safety practices of coal mines. The number of injuries and illnesses that would occur even with the safety measures applied is not quantifiable. There is no mitigation for impacts SE-1 through SE-9.

MONITORING, RESEARCH, AND STUDY PROGRAMS

The operators would be required to provide a monitoring program for measuring chemical quality and sediment yield from any surface discharge leaving the project area to insure that the SMCRA requirements are met.

A representative of BLM will annually inspect livestock grazing areas adjacent to mining operations to determine if such operations are affecting grazing patterns of the allotment, to determine if any range overuse is resulting from the changes in grazing patterns that may be occurring, and to determine measures to be applied to correct the overuse of the range.

As reclamation is accomplished, the compliance officer (state and federal) would conduct periodic inspections of mining areas to assure that reclamation is accomplished in accordance with an approved reclamation plan.

Reclaimed areas would be jointly inspected periodically by representatives of federal and state agencies and the operator to determine areas on which reclamation is completed and acceptable and to jointly determine corrective measures to be applied on areas where reclamation efforts have proven inadequate (e.g., seeding failure).

CHAPTER 5

ADVERSE IMPACTS THAT CANNOT BE AVOIDED

There would be no additional mitigating measures to reduce the air quality impacts. Therefore the annual emissions from the Seminoe I Mine are expected to be as shown in Table SI3-5.

Of the total annual total suspended particulates (TSP) emissions of 1,946 and 1,685 tons/year generated at the mine for the years 1980 and 1983 respectively, only about 2% would be applicable to the new interim regulations implemented by the EPA (43 CFR 118). The other 98% would be fugitive dust and are excluded from any air quality assessment. The Seminoe I Mine would not be expected to exceed the NAAQS nor the Class II increment under the new review procedure. However, fugitive dusts, to be controlled under best management practices, would still be the most significant air quality impacts resulting from strip mining.

Present impact is reflected in the existing ambient particulate concentrations of 31 micrograms per cubic meter ($\mu g/m^3$) with a maximum 24-hour concentrations of 86 to 71 $\mu g/m^3$ as recorded at the nearby Adams and Curry ranches (Chapter 2). Gaseous pollutant levels would also be expected to remain at their extremely low levels (Chapter 2).

Visibility would be expected to average 26 to 47 miles depending upon climatological conditions. During worst case fugitive dust conditions, visibility may be expected to decrease to about 12 miles, however this occurrence would be infrequent.

There would be no significant adverse impacts to geology.

Destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur due to the mining process and unauthorized collecting.

The destruction of natural features of the landscape would be unavoidable; the land surface would be slightly different than it was originally. After restoration, the average elevation of the strip mined area should be temporarily about the same as present, because the expansion of the overburden would tend to compensate for the removal of the coal seam. However, the mined area would partially recompact over many years, eventually lowering the average elevation by about 20 feet. Natural drainages would be permanently altered.

Disturbance and loss of soil productivity due to all activities on 1,480 acres cannot be avoided. Soil productivity lost on 25 acres (access road) and 20 acres (population needs) would be a long-term loss due to permanent utilization for other purposes. The productivity on 1,435 acres would be lost during periods of disturbance by mining activities. This loss would be temporary, since the acreage (1,435 acres) would eventually be reclaimed (10 to 15 years after the start of reclamation).

In the area to be mined (final contour), soil profiles and properties that have developed over geologic time would be destroyed on 1,405 acres. The existing soil biota and soil forming processes would be drastically altered. Conventional surface strip mining would destroy approximately 365 acres a year with a maximum of 875 acres of exposed area at any one time.

An estimated 25% of erosional losses on disturbed areas (areas of reclamation) would not be controlled. Haul road and access road fugitive dust levels would be reduced an estimated 50% by watering and chemical stabilization. There would be on estimated soil loss of 0.42 ton/acre/year due to wind erosion from overburden spoil piles.

Water use in the region would increase by 20 acre feet per year (ac ft/yr) until 1989 as a result of the project. This increase would be less than 0.1% of the regional water use and be negligible both in relation to present use and to water available in the region.

The development of the Seminoe I project would result in the destruction of 1,480 acres of native vegetation. Of this total, 20 acres would be utilized for housing and support service sites at various population centers, and the loss of native vegetation would be permanent. The remaining 1,460 acres that would be disturbed are located on or adjacent to the project area and the loss of vegetative cover would be of a temporary nature, since it would be reclaimed. Although vegetative cover of native species would be sustained for a period of 10 to 15 years which is the period considered necessary for full vegetative cover establishment and recovery of productivity.

Since the control of haul road dust and fugitive coal dust is projected to be approximately 50% effective, the palatability of vegetation adjacent to the disturbed areas would be affected while mining operations were being conducted.

It is anticipated that 1,460 acres of wildlife habitat would be removed by surface mining and construction of ancillary facilities. In spite of provisions for reclamation of this acreage, it would be lost as wildlife habitat until the end of mine life and until the end of the reclamation period. These losses could not be avoided. There would be minimal use of seeded grass on the reclaimed areas by both pronghorn and mule deer since their dietary habits include only about 10% grass over a year-round period. Sagebrush and greasewood that would provide suitable wildlife habitat for all species would not become reestab-

lished through natural succession for 40 to 50 years after reclamation was initiated.

The loss of habitat due to the project would not result in any significant reduction in either the pronghorn or mule deer populations, since so few of these animals occur on the project area. Surrounding habitat could absorb these displaced animals with no detrimental effects to the local populations. An estimated 57 sage grouse would be lost to all users over the period of mine life. These losses would be unavoidable.

Losses to raptors would be minimal, since there is only one buteo nest that would be destroyed.

It is anticipated that the increase in the human population due to increased employment in the project area would also increase losses from poaching, wanton destruction, harrassment, and animal/vehicle collisions. These losses also could not be avoided.

The effective mitigation of adverse impacts to subsurface cultural resources would depend upon several factors. These factors include; (1) successfully predicting areas of likely subsurface sites, (2) the amount of destruction which occurred to a site as it was being unearthed, and (3) the ability and willingness of workers to recognize and report cultural resources when they are discovered in the absence of a professional archeologist.

The proposed coal mining would lower the scenic quality of the landscape character of the Seminoe I project area. During mining the area would be lowered from Visual Resource Management (VRM) Class III to Class V. Spoil piles, pit headwalls, coal storage, and topsoil piles would alter the landscape character. Roads, power lines, phone lines, and other structures would remain until removed and the site is revegetated. The changes to line, form, color, and texture would be obviously visible until vegetation is successfully reestablished. Upon successful reclamation, the area could be returned to a Class III.

Recreational access would be restricted during mining in the Seminoe I project area. As the mine becomes developed, people would come to the area to view the mining activities. Those activities which would be affected by the access restrictions on site would be hunting, sightseeing, and off-road vehicle travel.

Increased population would result in increased recreational use throughout the southcentral Wyoming region. This increased use would result in lowering the quality of the existing type of outdoor recreational experience. Also, due to increased use, ranchers in the area would restrict access across their private lands. The urban recreation facilities in Hanna, Saratoga, and Rawlins would experience the largest increase in use.

Table SI3-11 depicts estimated visitor use change due to the proposed coal mining. The numbers illustrate the changes in recreation use due to population increases in the region.

The destruction of vegetation through the development of the Seminoe I project would result in an unavoidable loss of grazing on the Quealy Block and Dana Meadows North grazing allotments. This grazing loss would be extended over a 10 to 15 year period during which vegetative cover suitable as sheep range would be restored. The grazing loss sustained during this period would be approximately 2,190 animal unit months.

The removal of 5.2 million tons of coal for power generation would reduce Wyoming's coal reserves by about 0.01%. Dilution caused by use of large equipment for rapid removal of overburden and coal, would result in an additional loss of 0.57 million tons.

The 24,600 cubic yards of scoria (clinker) needed for road construction would not be recoverable at the end of mining operations.

The Seminoe I project would cause a shortage of 12 workers in other sectors of the economy by 1980. The Seminoe I project would increase total wage earnings $1.2 million in the region, creating local inflationary pressures, and reducing the buying power of people on fixed incomes.

This same inflationary trend would force the price of housing higher, creating crowded housing conditions and forcing people to accept housing that is not up to their expectations or desires.

Congestion on local access roads would increase slightly, especially during shift changes.

CHAPTER 6

SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

Approval of this mining and reclamation plan amendment would allow mining of 5.2 million tons of coal over a period of 4 years to meet national energy demands outside this region. Since the proposal is an expansion of the existing Seminoe I Mine, the net effect would be an extension of the present mine life. After reclamation, the area would be used for livestock grazing and wildlife habitat.

The short-term use of the mine site would expose or disturb over 3,500 acres of land surface over the life of the mine. The air pollution caused by the mining operation during coal extraction would be a short-term event which would cease at the end of the mine life. The largest potential threat to long-term productivity in terms of air quality is the failure of complete reclamation of the exposed and disturbed acreage. Wind erosion could continue to generate fugitive dust emissions from the mine site if a proper vegetative cover is not established. If however, land reclamation is successful, no long-term problems from wind erosion may be expected. Since the land would be returned to grazing and wildlife forage, the long-term effects of mining should be nonexistent.

No other long-term air quality impacts are expected as a result of the short-term impacts and activities.

The short-term use of the soil resource by mining activities would disrupt the productivity levels and increase soil losses on 1,435 acres. Potential productivity levels would be restored to an estimated 100% of premining levels with successful reclamation. The long-term utilization of 25 acres for access road and 20 acres for urban needs would remove 45 acres of soils for an alternate use.

All commitment of water resources would be short term (for the life of the mine), and would have no affect on long-term productivity of the project area.

In the long term, the premining vegetative composition and productivity would be attained and would be capable of supporting premining uses. The short-term loss would be the vegetative cover and productivity on 1,460 acres of land used in mining development, of which 1,435 acres would be reclaimed over a 10 to 15 year period.

The use of 20 acres as housing and support service sites and the 25 acres in permanent roads would result in a long-term loss of native vegetation and productivity on those acres. This loss would be a result of a change of land use from premining use.

In the short term there would be loss of habitat on 1,460 acres of land used in mining activities; the loss of an estimated 57 sage grouse; and heavy losses, that are not quantifiable, of small rodents, small songbirds, mourning doves, cottontail rabbits, and reptiles over the 1,460 acres. The displacement of an estimated ten pronghorns into adjacent areas would occur, as well as the displacement of an estimated seven mule deer into adjacent areas.

In the long term, a vegetative complex similar to premining habitat would be attained and would be capable of supporting premining populations of wildlife after 10 to 15 years of reclamation.

A long-term commitment of cultural resources would result from the destruction of sites. If all sites were left in situ, more information could possibly be extracted from the site by improved techniques in the future. Due to proposed mining at Seminoe I, the intensive cultural inventory for this area has been greatly accelerated.

Short-term improvements to Class V areas could be achieved when mined areas are reclaimed. Long-term improvement would be achieved by revegetation, natural plant succession, removal of mine equipment and power lines, and restoration of waste disposal areas.

The development of the Seminoe I project would cause the destruction of 1,460 acres of sheep range which would result in a short-term loss of sheep grazing (2,190 animal unit months). Reclamation of the lands to premining vegetative composition and productivity would allow grazing at the premining level.

The stockwater pond that would be destroyed or rendered useless would result in a short-term loss of the use of the facility. The long-term use would not be affected since the facility would be restored during reclamation and premining use reestablished.

Development of the proposed mine would change the nature of the primary recreational activity (hunting) since most of the reclaimed areas would not be suitable for wildlife habitat for a long period of time. As human activity increases at the mine, increases in all recreation activities would occur in the short term owing to the increase in population and loss of the recreation land base. In the long term, recreation use on the area could resume with removal of mining equipment, successful reclamation, and reestablishment of wildlife plant species.

A short-term trend would be the tendency for recreational vistors to go elsewhere in the region, thus impacting other areas. This trend could reverse in the long term.

The major trade-off in mineral resources would be between the short-term use of the coal, sand, gravel, scoria, oil, and diesel fuel and the long-term availability of these resources.

SHORT TERM VS. LONG TERM

In the short term, the increased employment at the Seminoe I project would create labor shortages in othe regionalr sectors of the economy. In the long term, as more people move into the region, a labor force of sufficient size to meet the needs of all employers would be available. In addition, this increased employment would tend to hold the unemployment rate at its current low level.

Increased wage earnings would in turn increase retail and wholesale trade over the life of the mine. This would be a short-term gain while the loss of buying power of people on fixed incomes would be long term.

In the short term, housing prices would rise and crowded conditions would occur. However, over the long term the housing stock would increase, allowing such crowded conditions to subside.

Health care in these region may never be considered up to standard, but over the long term the population/health care specialist ratios would return to at least the current levels. Impacts directly associated with mining of coal would be short term in nature and would disappear when the mining ceases at the project.

Work-related injuries and illness would be short-term losses due to the proposed action. Those injuries or illnesses which are fatal or debilitating would reduce long-term human productivity.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Implementation of the project would result in commitments to use the area more intensively and would significantly alter the use of various resources. The use and consumption of land and resources would be irreversible (once initiated, use and impacts would continue and could not be reversed for a long time, if at all) or irretrievable (irrecoverable for a long period of time or permanently). Irreversible refers to trends; irretrievable refers to loss of resources for other uses. Some commitments are both irreversible and irretrievable.

Soils, vegetation, wildlife, and present land uses on the proposed project area would be irreversibly committed during the life of the project and thereafter until reclaimed or reestablished. Air and water would be irreversibly committed during the life of the project to the extent that air quality would be degraded and water used by the project would not be available for other uses. A major irretrievable commitment would be the removal of 5.2 million tons of coal, which would be permanently lost and therefore not available to future generations. Cultural values, construction materials, fuels, and any loss of human life would also be irretrievable if the project should be implemented.

This chapter summarizes and quantifies where possible these types of resource commitments for the entire project to provide a total picture of what implementation of the project would involve.

An irretrievable commitment of an undetermined number of uninventoried, exposed and unexposed fossil localities would result from mining as well as an increase in unauthorized fossil collecting. The destruction resulting to the resources would be an irretrievable commitment.

The destruction of existing soil profiles and loss of soil by erosion (unquantifiable) occurring on 1,460 acres would be an irretrievable loss. The soil productivity lost on 25 acres (access road) and 20 acres (population needs) would be irretrievable since the soil resource would be used for an alternate use.

The loss of native vegetation and associated productivity on the 25 acres used as a permanent road and 20 acres utilized in housing and support service sites would be an irreversible and irretrievable loss to the range resource.

The loss of wildlife habitat on the 25 acres used as a permanent road and 20 acres used for housing would be an irretrievable and irreversible loss to the wildlife resource.

The destruction of sites would be an irreversible and irretrievable commitment of the resource.

Because of soil variations, slopes, and climate, vegetative reclamation scars on the landscape would be evident. These scars would cause an effect upon the landscape due to the difference in form, color, and texture of surrounding vegetation on reclaimed areas. However, the area could be returned to a Class III.

The coal related population increases would impact recreational activity (primarily hunting). Although some of the coal related population would leave once mining was completed, the regional population increase would cause an irreversible impact on recreation resources.

The major commitment of resources would be the 5.2 million tons of coal produced during the extended (4 years) projected life of the mine. Of this total, all 5.2 million tons would be mined and utilized in power production by 1990. There would be an additional 0.57 million tons left in place since they would not be recoverable by present mining techniques.

The 24,600 cubic yards of scoria for road construction would for all practical purposes be irretrievable because replacement under prevailing natural conditions may take centuries. Transportation of the coal resource would require an estimated 72,800 gallons of diesel fuel per year which would come from domestic or imported oil sources. An additional indeterminate amount of diesel fuel would be required to transport coal from the regional boundary to markets.

The Seminoe I project would irreversibly reduce the buying power of people on fixed incomes. The buying power they lose during times of inflation would never be regained.

Fatal or debilitating injuries and illnesses would be an irreplaceable loss of the human resource.

Community expansion would lead to an irreversible change in land use from rangeland to residential around and near those communities receiving population from this mine.

CHAPTER 8

ALTERNATIVES

The Geological Survey (GS) has accepted the Seminoe I Mining and Reclamation Plan Amendment as adequate for environmental review and consideration for subsequent approval under 30 CFR 211 regulations as of May, 1976. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing law and regulations. He may also defer decision pending submission of additional data, completion of required studies, or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary. The regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technologic improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO-ACTION ALTERNATIVE

Under the no-action alternative, the GS would not approve the mining and reclamation plan as submitted for the Seminoe I project. In this event, it is anticipated that the coal controlled by private interests would be mined in logical sequence, assuming Wyoming DEQ issues the appropriate permits. This operation would be conducted over a 3-year period with a total production of approximately 3.8 million tons of coal (approximately 73% of the coal in the project area). If the permit is not issued, the federal coal resource (1.4 million tons) bypassed would be irretrievably lost. Other impacts would be similar to the impacts of the proposed action (Chapter 3), since the coal controlled by private interests would be mined.

DEFER ACTION

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan for provide for changes which reduce impacts or provide for acquisition of additional data and further evaluation.

Changes or mitigation beyond those already discussed in Chapter 4 which would further reduce impacts are identified in the fish and wildlife alternative, visual resource alternative, and the alternative addressing air quality impacts.

Under this alternative, action could be deferred until the company demonstrates in their present Hanna Basin operations that reclamation on mined areas can be accomplished to meet the standards outlined in the Surface Mining Control and Reclamation Act (SMCRA). It is estimated that a judgment on initial reclamation success could be made in 3 to 5 years. However, reclamation efforts would be monitored by the authorized agencies and the determination would be made based on actual findings.

Delaying approval of the proposed mine and reclamation plan would result in impacts to the coal market area, i.e., coal from an alternate source would have to be acquired to replace the 1.4 million tons of federal coal.

PREVENT DEVELOPMENT ON THE LEASE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different designed course of action by the lessee (operator). This may be accomplished by suspension of operation (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. Any of these would have the effect of precluding development.

If development of the existing lease were prevented, the federal coal would be left in place and not recovered for use. To replace the resource foregone by this alternative course of action, other comparable quantities of coal would be required to substitute in the marketplace for this supply. Other impacts would be similar to those described in Chapter 3, since the private coal (73% of the total coal in the project area) would be mined even though development of the federal coal would not be allowed.

RESTRICT DEVELOPMENT ON THE LEASE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc.

Impacts due to this alternative would be similar to those described in Chapter 3.

APPROVE THIS MINING PLAN AFTER MODIFICATION

Best Management Practice Air Quality Alternative

Haul and access roads would be the two largest sources of fugitive particulate emissions at the proposed site. Chemically stabilizing the haul roads and paving the access road are two alternatives which would effectively control a significant portion of the fugitive emissions generated by these sources. Chemical stabilization of the haul roads would generally control 50% to 75% of haul road emissions and paving would be 85% effective in controlling emissions from the access road. Wind erosion from these sources would also be significantly reduced. Other possible alternatives not chosen for the access road are chemincal stabilization and watering of the access road during shift changes since lower control efficiencies would be realized as opposed to paving.

Wind erosion from other exposed areas and dragline and topsoil removal operations would also be significant sources of fugitive dust however, these emissions cannot practically be controlled. Another significant source of fugitive dust emissions would be open storage of the raw coal prior to washing operations. The use of enclosed storage could essentially eliminate emissions from this source.

Table SI8-1 shows the total annual emissions for each study year as was presented in Chapter 3, the total reduction in annual emissions that would result from the above alternatives, and the total annual emissions expected if the above alternatives were employed. An average control effectiveness of 62.5% for chemical stabilization was used in making the calculations.

The reduction in annual emissions would result in a lessening of air quality impact. It is predicted that if the alternatives were applied the resultant ambient air quality in the area of the mine site would have a geometric mean of 24 to 27 micrograms per cubic meter ($\mu g/m^3$) on an annual basis. The 24-hour maximum values would be expected to be about 100 to 105 $\mu g/m^3$. All of these values are well below the Wyoming State standards.

The use of the alternatives would have no effect on reducing gaseous emissions from mine vehicles. However, even without a reduction in sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), or hydrocarbons (HC) emissions, no significant air quality impact would be predicted. Present levels of these pollutants are far below the standards and only insignificant amounts of these pollutants would be released from vehicles at the mine site.

Visibility at the mine site and near the access road would be improved by the reduction in fugitive dust. Visibility during the worst 24-hour case is not expected to fall below 15 miles near the mine site as opposed to 13 miles as predicted without the alternatives (Chapter 3). For the most part visibility would be expected to average 26 to 47 miles depending on climatological conditions such as fog, rain, and snow.

A number of the impacts identified and described in Chapter 3 of this statement could be more fully mitigated by the selective application of those measures described below that are supplemental to the proposed action described in Chapter 1. They follow the best management practices recommended by the Environmental Protection Agency in comments provided on the Southwestern Wyoming Regional Coal ES. The measures to reduce impacts are analyzed here as an alternative, but will probably be adopted as required measures in the final environmental statement and the impact analysis modified accordingly.

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decisionmaker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects on vegetation, soils, wildlife, etc., by reducing the area in which the impacting activities could take place. However, implementation of this alternative would not permit maximum recovery of the coal resources.

FISH AND WILDLIFE MITIGATION ALTERNATIVE

The recommendations listed in this alternative, if implemented, could significantly reduce the major impacts

Table SI8-1

TOTAL ANNUAL EMISSIONS FOR EACH STUDY YEAR WITH CHEMICAL STABILIZATION OF HAUL ROADS, PAVED ACCESS ROAD, AND ENCLOSED COAL STORAGE

Study Year	Annual Chapter 3 TSP emissions (tons/year)	Total best management practice TSP emissions (tons/year)	Expected emission reductions (tons/year)	Expected reduction in emissions (%)
1980	1,946	1,523	423	22
1983	1,685	1,232	453	27

to the existing wildlife populations occurring on the Seminoe I site.

Environmental Recommendations

1. All disturbed areas scheduled to be reclaimed should include the following browse species in the seeding mix; big sagebrush, winterfat, fourwing saltbush, and rabbitbrush. Seeding rates of these species should follow recommendations in Plummer et al 1968.

2. Potted shrubs should be established in clusters behind snow fences so that protection and additional moisture afforded by the snow would increase the likelihood of shrub cover being quickly established.

3. All reclaimed areas should be fenced against grazing by livestock and pronghorns so that shrubs will become quickly established. All fences will be constructed in a manner that would not be a hazard to wildlife.

4. That mine permits will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for substitute mining practices, buffer zones, prey base, and alternate nest sites.

CHAPTER 9

CONSULTATION AND COORDINATION

See the Regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in preparation of the draft ES.

SEMINOE I APPENDIX

SOIL MAPPING UNITS

90B-Blazon loam, 5% to 15% slopes

These gently sloping to moderately steep soils occur throughout the survey area. The slopes range from 5% to 15%, but are mostly about 10%. Small areas of Shinbara and Satanka soils and rock outcrop are included in this mapping unit.

The Blazon series is a shallow, well drained soil. It is formed in shallow loamy deposits weathered from interbedded sandstone and shale. Typically the surface layer is a brown, moderately alkaline clay loam about 5 inches thick. The substratum is a pale brown, moderately alkaline clay loam about 11 inches thick. Interbedded sandstone and shale deposits occur at 16 inches.

210-Ravalli-Forelle-15 complex, 0% to 6% slopes

These nearly level and gently sloping soils are on alluvial fans, terraces, and drainageways. The Ravalli soil makes up about 30% of the mapping unit, the Forelle soil about 30% and the 15 soil about 25%. The Ravalli soil differs from the Forelle and 15 soils by having a higher sodium content in the subsoil. The Forelle soil differs from the 15 soil by having a distinct clay accumulation in the subsoil. About 15% of the unit is Bullock and Rock River soils.

The Ravalli series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is yellowish brown, mildly alkaline sandy loam about 2 inches thick. The upper part of the subsoil is yellowish brown, moderately alkaline loam about 3 inches thick. The center part of the subsoil is brown, moderately alkaline loam about 9 inches thick. The lower part of the subsoil is very pale brown, very strongly alkaline clay loam about 6 inches thick. The upper part of the substratum is pale brown, very strongly alkaline loam about 5 inches thick. The lower part of the substratum is pale brown, very strongly alkaline very fine sandy loam to 60 inches or more.

The Forelle series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is grayish brown, mildly alkaline loam about 4 inches thick. The upper part of the subsoil is yellowish brown, mildly alkaline clay loam about 11 inches thick. The center part of the subsoil is yellowish brown, mildly alkaline clay loam about 14 inches thick. The lower part of the subsoil is pale brown, moderately alkaline clay loam about 16 inches thick. The substratum is pale brown, moderately alkaline loam extending to 60 inches or more.

The 15 series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is pale brown, moderately alkaline loam about 2 inches thick. The subsoil is light yellowish brown, moderately alkaline loam about 6 inches thick. The upper part of the substratum is pale brown, moderately alkaline loam about 37 inches thick. The lower part of the substratum is brown, moderately alkaline sandy loam to a depth of 60 inches or more.

251-Grieves-Blackhall association 2% to 20% slopes

This association consists of sloping to moderately steep upper slopes and ridge crests. Grieves sandy loam makes up about 55% of the mapping unit and Blackhall sandy loam makes up about 30%. Grieves soils occur on alluvial fans and gently sloping uplands. Blackhall soils occur on sloping to moderately steep upper slopes and ridge crests. Included in this unit are areas of Carmody soils and rock outcrop. These inclusions make up about 15% of the total acreage.

The Grieves soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 5 inches thick. The subsurface layer is brown sandy loam about 6 inches thick. The substratum is pale brown sandy loam to a depth of 60 inches.

The Blackhall soil is a shallow, well drained, soil forming over soft sandstone residuum. Typically, the surface layer is brown sandy loam about 2 inches thick. The substratum is light yellowish brown sandy loam to a depth of 17 inches. Soft, pale yellow, calcareous sandstone occurs at 17 inches.

252-Shinbara-Blazon-Rock Outcrop complex, 6% to 30% slopes

These sloping to steep soils are on bedrock controlled uplands. The Shinbara soil makes up about 35% of the mapping unit, the Blazon soil about 30% and Rock outcrops about 25%. The Shinbara soils differ from the Blazon soils by being shallower to bedrock. About 10% of the unit is Delphill and Tasselman soils.

The Shinbara series is a very shallow, excessively drained soil. It formed in very shallow loamy deposits weathered from shale interbedded with sandstone. Typically the surface layer is brown, strongly alkaline loam about 3 inches thick. The substratum is strongly alkaline silty clay loam about 3 inches thick. Soft fractured shale and coal occurs at 6 inches.

The Blazon series is a shallow, well drained soil. It formed in shallow loamy deposits weathered from interbedded sandstone and shale. Typically the surface layer is brown, moderately alkaline clay loam about 5 inches thick. The substratum is pale brown, moderately alkaline clay loam about 11 inches thick. Interbedded sandstone and shale deposits occur at 16 inches.

253-Blazon-Santanka association 2% to 15% slopes

This association consists of gently sloping to moderately steep residual uplands. Blazon loam makes up about 40% of the mapping unit and Satanka sandy loam makes up about 35%. Blazon soils occur on ridge crests and upper slope areas. Satanka soils occur on concave midslope and lower slope areas. Included in this unit are areas of Delphill and Shinbara soils and rock outcrop. These inclusions make up about 15% of the total acreage.

The Satanka soil is a moderately deep, well drained, soil forming over interbedded sandstone, siltstone, and shale residuum. Typically, the surface layer is brown sandy loam about 3 inches thick. The upper part of the subsoil is brown sandy clay loam about 7 inches thick. The lower part of the subsoil is pale brown loam about 3 inches thick. The upper part of the substratum is very pale brown loam about 14 inches thick. The lower part of the substratum is gray silty clay about 8 inches thick. Soft, calcareous, interbedded sandstone, siltstone, and shale occurs at 35 inches.

254-Bullock-Blazon complex, 0% to 6% slopes

These nearly level and gently sloping soils are adjacent to upland drainageways. The Bullock soil makes up about 45% of the mapping unit and the Blazon soil about 35%. The Bullock soil differs from the Blazon soil by being deeper to bedrock and having distinct structure in the subsoil. About 20% of the unit is Ravalli and 15 soils. The Bullock series is a moderately deep, well drained soil. It formed in loamy deposits weathered from shale interbedded with sandstone.

Typically the surface layer is light gray, moderately alkaline sandy loam about 3 inches thick. The upper subsoil is yellowish brown, moderately strongly alkaline silty clay about 13 inches thick. The substratum is dark grayish brown, moderately alkaline silty clay about 6 inches thick. Soft shale and coal occurs at about 32 inches.

256-McFadden-Rock River complex, 0% to 20% slopes

These nearly level to moderately steep soils are on high river terraces and slope breaks on alluvial fans. The McFadden soil makes up about 50% of the mapping unit and the Rock River soil about 30%. The McFadden soil differs from the Rock River soil by having more carbonates and coarse fragments in the soil profile. About 20% of the mapping unit is 15 soils and soils that are moderately deep to bedrock.

The McFadden series is a deep well drained soil. It formed in gravelly calcareous alluvium. Typically the surface layer is brown, moderately alkaline gravelly sandy loam about 4 inches thick. The subsoil is brown, moderately alkaline gravelly sandy loam about 9 inches thick. The substratum is pale brown, strongly alkaline sandy loam to a depth of 60 inches or more.

257-Havre and Glendive soils 0% to 3% slopes

This undifferentiated unit consists of soils in narrow flooding drainageways. Each component of this mapping unit may occur in each delineated area, or they may occur separately. Included in this unit are areas of 15 soils. The inclusions make up about 15% of the total acreage.

The Havre soil is a deep, well drained, soil forming in stratified alluvium. Typically the surface layer is grayish brown loam about 3 inches thick. The substratum is brown, silty clay loam to a depth of 60 inches.

The Glendive soil is a deep, well drained, soil forming in stratified alluvium. Typically, the surface layer is brown fine sandy loam about 4 inches thick. The substratum is pale brown fine sandy loam to a depth of 60 inches.

258-Rock River-Satanka association 0% to 12% slopes

This association consists of level to sloping alluvial fans and adjacent uplands. Rock River sandy loam makes up about 45% of the mapping unit and Satanka sandy loam makes up about 35%. Rock River soils occur on alluvial fans and narrow drainages. Satanka soils occur on the sloping ridges and concave upperslopes. Included in this unit are areas of Blazon and Blackhall soils and rock outcrop. These inclusions make up about 20% of the total acreage.

The Rock River soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 2 inches thick. The subsoil is brown sandy clay loam about 10 inches thick. The substratum is calcareous, yellowish brown sandy loam to a depth of 60 inches.

260-Ryan Park-Rock River association 2% to 20% slopes

This mapping unit consists of gently sloping to moderately steep alluvial fans. Ryan Park sandy loam makes up about 45% of the mapping unit and Rock River sandy loam makes up about 30%. Ryan Park soils occur on the middle and upper portions of alluvial fans. Rock River soils occur on the lower portions of alluvial fans and alluvial bottoms. Included in this unit are areas of Grieves and Blackhall soils. These inclusions make up about 25% of the total acreage.

The Ryan Park soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 1 inch thick. The subsoil is yellowish brown sandy loam about 16 inches thick. The upper part of the substratum is pale brown sandy loam about 25 inches thick. The lower part of the substratum is yellowish brown sandy loam to a depth of 60 inches.

SEMINOE I APPENDIX

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES)[3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH)[6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Blackhall	10-20	Well to excessively drained	Very low 1.2-1.8	D	350-700	7.8-8.6	<2.0	Low	3	Medium to Rapid
Blazon	10-20	Well drained	Very Low to Low 2.7-3.1	D	500-1000	7.9-9.0	2.0-4.0	Low	4L	Rapid
Bullock	20-26	Well drained	Very Low to Low 2.14-3.52	D	420-720	6.6-9.0	<2.0-8.0	Low	6, 3	Slow
Forelle	>60	Well drained	High 9.25-11.75	B	500-1000	7.0-8.8	<2.0	High	5	Slow
Glendive	>60	Well drained	High 8.4-10.24	B	900-1800	6.6-9.0	2.0-8.0	Moderate	5	Slow
Grieves	>40	Well drained	Moderately High 7.2-8.4	B	700-1500	7.4-9.0	<4.0	Moderate	3	Medium
Havre	>60	Well drained	High 8.4-12.0	B	700-1600	7.4-8.4	2.0-12.0	Moderate	3	Slow
McFadden	13-20	Well drained	Moderately High	B	700-1500	8.0-8.8	<2.0-4.0	Low	3	Medium
Ravalli	>60	Well drained	Moderately High --	C	400-750	7.6-9.6	<4.0	Low	5	Slow
Rock River	>60	Well drained	Moderately High 7.0-8.3	B	700-1500	6.6-9.0	<2.0-4.0	Moderate	3	Slow

SEMINOE I APPENDIX
(Continued)

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES) [3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH) [6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Ryan Park	>60	Well drained	Low 3.6-4.9	B	700-1500	6.6-9.0	<4.0	Moderate	2	Medium
Santanka	35	Well drained	Low 3.5-5.5	B	600-1400	7.4-9.0	<2.0	Moderate	3	Medium
Shinbara	5-10	Somewhat excess-ively well drained	Very Low 0.75-2.0	D	250-600	8.2-8.8	2.0-4.0	Low	4L	Medium to Rapid
#15	>60	Well Drained	Moderately High	B	700-1200	8.0-8.4	----	Moderate	--	Medium

1. Depth of Effective Rooting Zone: Is an indicator of the depth to which plant roots would penetrate soil profile.
2. Drainage Class: Is an indication of soil profile-moisture relationships.
3. Available Water Capaicity: Refers to the soil profiles potential water holding capacity for utilization by plants.
4. Hydrologic Soil Group: This grouping places soils to their potential to yield runoff; Group A being low and Group D being high.
5. Potential Production (#/ac. Dry Wt.): Refers to SCS Form 5 Potential Vegetative Production calculations from unfavorable to favorable years for each series.
6. Soil Reaction (pH): The degree of acidity or alkalinity of a soil expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: slightly acid, 6.1-6.5; neutral, 6.6-7.3; slightly alkaline, 7.4-7.8; moderately alkaline 7.9-8.4; strongly alkaline, 8.5-9.0; and very strongly alkaline, 9.1.
7. Salinity (mmhos/cm): Refers to the soluble salts in a soil, based on the electrical conductivity of the saturation extract, as expressed in millimhos per centimeter (mmhos/cm) at 25 C.

Salinity rating	mmhos/cm
Low	4
Moderate	4-8
High	8

8. Inherent Fertility: The following criteria were used for rating the soils.
   Low Soils low in available P or K, or with pH below 5.0 and above 9.0 in the A and upper B horizons, or soils having levels of moisture (A.W.H.C.), or growth of plants is severely limited.
   Moderate Soils intermediate between low and high in inherent fertility.
   High Soils high in available P and K, with pH of 5.5 or less than 8.4 in the A and upper B horizons, levels of moisture (A.W.H.C.), or alkalinity are such that choices or growth of plants are not limited.
9. Wind Erodable Group: Refers to the erodability of soil surface; rate 1-8 with 1 being the most erodable and 8 being non-erosive.
10. Runoff: Refers to the relative rate that water flows off soil surface 6 classes: Ponded, very slow, slow, medium, rapid, very rapid.

SEMINOE I APPENDIX

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL[2]	CLASSIFICATION[3] DEPTHS (INCHES)	USDA	UNIFIED	AASHO	DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
Blackhall	251	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthent	Residuum from soft sandstones	0-12 0-12	FSL,VFSL GR-VFSL	SM, SM-SC SM	A-4 A-2,A-4	10-20	0.6-2.0	Low	Low
Blazon	252,253, 254	Loamy, mixed (calcarcous), frigid, shallow Ustic Torriorthent	Interbedded sandstone, loam stone and sandy shales	0-14 0-14 0-14	CL L GR-CL	CL ML, CL-ML GM	A-6 A-4 A-6	10-20	0.2-2.0	Low	Moderate Low Moderate
Bullock	254	Fine-loamy, mixed Borollic Natrargid	Residuum from interbedded soft sandstone and silty and clayey shales	0-4 0-4 4-9 9-22	FSL SIL, L SCL, CL, L SL, L, CL	SM,SM-SC,ML ML, CL-ML SC, CL SC,SM-SC,CL	A-4 A-4 A-4, A-6 A-4, A-6	20-40	0.6-2.0	Low	Low Low Moderate Moderate
Forelle	210,	Fine-loamy, mixed Borollic Haplargid	Alluvium from sandstones and shales	0-4 4-20 20-60	L CL, L GR-SCL	CL-ML, ML CL GC, SC	A-4 A-6 A-2	>60	0.6-20	Moderate	Low Moderate Moderate
Glendive	257	Coarse-loamy, mixed (calcareous), frigid Ustic Torrifluvent	Sandy alluvium on flood plains	0-16 16-60	L,SIL,FSL SR-FSL-LFS	ML,CL-ML SM	A-4 A-4, A-2	>60	0.6-2.0	Moderate	Low
Grieves	251	Coarse-loamy, mixed (calcareous), frigid Ustic Torriorthent	Alluvium from calcareous sandstone	0-14 14-60	FSL FSL	SM,SM-SC SM,SM-SC	A-4 A-4	>60	0.6-2.0	Low	Low

SEMINOE I APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL [2]	CLASSIFICATION [3] DEPTHS (INCHES)	USDA	UNIFIED	AASHO	DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
Harve	257	Fine-loamy, mixed (calcareous), frigid Ustic Torrifluvent	Stratified alluvium on flood plains and stream terraces	0-8	L	ML,CL,CL-ML	A-4	>60	0.2-0.6	Moderate	Low
				0-8	SICL	CL	A-6				Moderate
				8-60	L,FSL	ML	A-4				Low
McFadden	256	Coarse-loamy, mixed Borollic Calciorthid	Alluvium from gravelly sand-stones	0-4	GR-SL	GM,SM	A-2	>60	--	--	--
				4-13	GR-SL	GM,SM	A-2				
				13-25	SL	SM	A-2, A-4				
				25-60	SL	SM	A-2, A-4				
Ravalli	210	Fine-loamy, mixed Borollic Natrargid	Alluvium from alkaline shales	0-2	SL	SM	A-4, A-2	>60	0.06-0.2	Low	Moderate
				2-14	L	ML	A-4				
				14-20	CL	CL	A-6				
				20-60	L, VFSL	ML	A-4				
Rock River	258 260 256	Fine-loamy, mixed Borollic Haplargid	Alluvium from sandstone	0-3	SL	SM	A-2	>60	0.6-2.0	Low	Low
				3-19	SCL	SM, SM-SC	A-4				
				19-60	SL	SM	A-2				
Ryan Park	260	Coarse-loamy, mixed Borollic Haplargid	Alluvium from sandstone	0-4	LFS,SL,LS	SM	A-2	>60	2.0-6.0	Low	Low
				4-18	SL,FSL	SM-SC	A-2, A-4				
				18-60	SL,LS	SM	A-2, A-4				
Satanka	258, 253	Fine-loamy, mixed Borollic Haplargid	Residuum from soft sedimentary rocks	0-4	FSL	SM	A-4	35	0.6-2.0	Low	Low
				0-4	GR-FSL	GM, SM	A-2				
				4-35	SCL GR-SCL	SC,GC	A-2, A-6				
Shinbara	252	Loamy, mixed (calcar-eous), frigid, shallow Ustic Torriorthent	Residuum from siltstone and loamstone	0-8	L	CL-ML, ML	A-4	2-10	0.6-2.0	Low	Low
				0-8	GR-L	CM-GC, GM	A-4				

SEMINOE I APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL [2]	CLASSIFICATION [3]				DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
				DEPTHS (INCHES)	USDA	UNIFIED	AASHO				
#15	210	Fine-loamy mixed Borollic Camborthid	Alluvium	0-45 45-60	L SL	---	---	>60	---	---	---

1. Classification: Classification of each soil series according to Soil Taxonomy USDA 1975.

2. Parent Material: Geologic material that soil developed from.

3. Classification: Depths are of soil profiles, USDA classification is the soil textural classification system, the unified and AASHO classifications are used by engineers unfamiliar with the USDA textrual classification system.

4. Depth To Bedrock: Refers to the soil range in depth to bedrock.

5. Permeability: Refers to the rate at which water and air may move through the soil.

6. Potential Frost Action: Refers to the probable effects on structures resulting from the freezing and thawing of soils.

7. Shrink/Swell Potential: Refers to the quality of a soil that determines its volumemetic changes resulting from wetting and drying of soil profile.